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OBITUARY—ROBERT PAULSON SPICE.

With profound sorrow we lay before our readers the lamentable fact that death has stilled forever the kindly heart and honest purpose that animated and governed the frame and force of Robert Paulson Spice, a member of the fraternity who, owing allegiance by birth and will to England, may yet be said to have been, in the fullest and best sense, a cosmopolitan. Certain it is that American gas engineers will share to the full the sorrow of their English brethren over the loss of one who adorned their common profession with a life of brightness and of honor; nor will that sorrow be lightened in the reflection that seventy-five years of time had cast its span over him between the cradle and the grave. We are jealous of death when his stern mandate robs us of youth that we admire or love; we are sullen when his decree takes from us age that we look up to with the eye and the hope of a pupil.

Deceased passed away suddenly and painlessly (at London) on the morning of Saturday, May 11, the primal cause being heart failure, superinduced by a congestive chill.

While we cannot claim that he had been closely identified with American gas engineering in a practical way, nevertheless, on his visit to this country, in 1885—a visit by-the-way, which he had repeated annually since—he attended the Cincinnati Convention of the American Association, on which occasion the Association elected him to Honorary Membership. Another tie that bound him to America was in the fact that his only son—Prof. Spice—is a resident of Brooklyn, N. Y., and who now acts as the Gas Inspector for that city.

In conclusion we give the following abstract of Mr. Spice's connection with the English gas industry, compiled from the columns of the London *Journal*: His was a unique place in the ranks of professional men, which can never be filled by another. He belonged to an order of gas engineers who have almost died out. His connection with the management of gas undertakings began with the construction of the works for lighting his native town of Fakenham, in Norfolk, where he was at the time carrying on the business of an iron-monger. Leaving this place, he settled in Richmond, Surrey, where he devoted himself to the management of gas works under leases, according to a very general practice of the time. He opened offices on Cornhill in 1860, about which date and for several years following he was lessee of the gas works at Wandsworth, Hampton Court, Richmond, and Watford. He also built gas works at Great Yarmouth, Boston (Lincolnshire), Tunbridge Wells, Tattershall, Abingdon, Hartley Wintney, Hoddesdon, and other places. Thus, like most other gas engineers of his epoch, he grew into his place by experience, and held it by a native aptitude for the business of his choice. He was largely consulted by gas companies and local authorities for arbitrations, rating appeals, etc.; and he had an extensive parliamentary practice. He possessed the gifts necessary for an expert—ready wit, keen appreciation of the bearings of a situation, and facility of expression.

He was a regular supporter of the British Association of Gas Managers; often speaking at the meetings. He was elected a member in 1868, and was President for 1876-7, from which period dates the Benevolent Fund, whereof he was one of the first supporters, and moved the resolution upon which the fund was established. Besides being

a Past-President of The Gas Institute, Mr. Spice was a Member of the Institution of Civil Engineers, a Member of the Institution of Mechanical Engineers, a Past-President of the Society of Engineers, a Fellow of the Royal Geographical Society, and a very distinguished Freemason. His engineering work has covered a period of a half century; for there is an inscription still in existence, taken from the old Hoddesdon works, bearing the words "R. P. Spice, Engineer, 1847;" and this, as already stated, was not his first piece of construction. That he retained his activity to the end is shown by the fact that his last new gas works, at Riddings, are only just completed, and we believe still await the final certificate.

All who knew Robert Paulson Spice will join with us in lamenting his loss; for a kinder heart never beat. Benevolent to a fault, many went to him in distress and received relief. He was only too open with his hand, and too ready with his support for all who appealed to him for help. He has become known to a wider circle than even his friends and acquaintances through the simple chatty little books in which he was accustomed to write the records of his journeyings as the "Hermit of Westminster," and which reveal his kindly nature.

Strong partisan as he was, it may be doubted if he has left an enemy in the world. Certainly, there is none that ever knew him, whether as friend or opponent, but will hear with sorrow that the wanderings and work of the Hermit are over.

The Guild Visits Lawrence, Mass.

"Dear JOURNAL:—The May outing of the Guild of Gas Managers was held in Lawrence this year, where the party enjoyed to the full an invitation from the Lawrence Gas Company, pleasantly reinforced by the special and generous hospitality of the Company's Agent, Mr. C. J. R. Humphreys. A large representation was had, those present being Messrs. C. F. Prichard (President of the Guild), A. B. Slater, O. E. Cushing, A. K. Quinn, G. B. Neal, W. A. Learned, H. B. Leach, C. A. Coffin, John Andrew and G. D. Cabot, with F. J. Davis, C. M. Coburn, W. H. Spaulding, C. S. Waldo, Wm. Anderson, B. W. Sprague, Ed. C. Jones, Z. M. Jenks, W. H. Down, F. C. Sherman, John P. Harbison, A. E. Perry, G. P. Gates (Treasurer Lawrence Company), John Fallon (a Director in the Company), H. H. Church (Supt. of works), and W. H. Volvekamp (the Company's electrician). The guests left Boston in special car, kindly placed at their disposal by the B. & M. Railroad, at 10:30 A.M. of Friday, and arrived in Lawrence something like an hour later. Agent Humphreys met them at the depot, from whence in barges they were driven to the office of the Lawrence Company, where a brief stop was made for the purpose of seating the local gas contingent. The route was then to the works, where a profitable hour or so was spent in looking over the plant, the especial features whereof are the Humphreys' regenerative furnace, the handsome exhauster house and equipment, and the means used by the clever Agent for working up the ammonia. The electric lighting station also came in for a goodly share of attention. At 1:30 the barges—otherwise known as 'busses—were again taken, the destination this time being the Humphreys residence on Prospect Hill. Lawrence is ordinarily a beautiful place, and the Hill is one of its crowning glories. When to this is added the result of the present mild and even spring, with its alternate warm rains and bright sunshine, one can imagine how gloriously the rich hue and tint of foliage and flower set off the prospect. Humphreys enjoys the distinction of living in a roomy residence located squarely in the center of a four-acre plot, the lawns of which "slope gently down to the confines of his domain." The temperature was just right, and the sunshine was magnificent—together these fitted the party out to thoroughly enjoy a good dinner, the tables for which were arranged on the broad verandah that hems the house. The tables were prettily laid in flowers and ferns—a woman's deftness was surely shown in this—and the catering was well attended to by the Lawrence Coffee House.

"Dinner over, the barges took the party to the steamboat landing on the Merrimac river, close to the Essex Company's dam, from whence the Henrietta swung up the river in the direction of Cushing's bailiwick of Lowell. The river never looked more beautiful, and the panorama of its breast and banks gave rise to admiration, increasing as the path was lengthened. The beautiful scene culminated in what is known as the 'Narrows,' and from that point the route was Lawrenceward. The 7 miles were all but too quickly covered, and at 6 P. M. the delighted voyagers were in the Boston and Lowell depot and *en route* for home. It may be easily understood that Humphrey's had the voice and vote of all for his hospitality and the nice way in which it was carried out, and I think all the participants will subscribe to the verdict that May 24, 1889, will often be recalled with pleasure by the Guild. In closing, I might remark that our satisfaction would have been replete were it so that Mr. Stiness, who is not in rugged health just now, could have been with us. To which I might add that it was unfortunate that Secretary Spaulding and Mr. Taber could not find it possible to separate themselves from pressing business that held them to their works.—EASTERNER."

[OFFICIAL REPORT.—Continued from p. 695.]

Twelfth Annual Meeting of the Western Gas Association.

HELD AT CINCINNATI, OHIO, MAY 15, 16, AND 17, 1889.

FIRST DAY—AFTERNOON SESSION.

Mr. Charles R. Faben, Jr., Toledo, Ohio, followed with his paper on

FUEL GAS.

The subject assigned by the committee is one of importance at the present time, and covering the great field that it does, the duty of preparing a paper upon such a subject should properly have been assigned to some person who could have treated the matter scientifically; but unfortunately I have been assigned the duty, and we, therefore, must regard the whole subject from the more practical side of the problem.

Fuel and light are prominent among the subjects that to-day occupy the thoughts of the public at large. The talents, skill and ingenuity of both scientist and engineer are being taxed—the former to produce a theory, and the latter to put into successful plan and operation the theory of the former. From the title of this paper we may entirely ignore the subject of light and consider the matter of fuel only.

The first question, then, that presents itself is, "What is fuel?" Fuel may be defined as representing any substance which is capable of entering into combination with another substance, and in so doing gives rise to the phenomenon of heat. In thus defining fuel, one would expect to find upon our earth a great variety of substances that might be classed as fuel; but upon further thought and closer investigation the variety of substances available as fuel may be said to be extremely limited. An authority upon the subject makes use of the following language, to-wit:

"In looking at the solid crust of the earth, we find it to be composed for the most part of siliceous, calcareous and magnesian rock; the former, silica, consisting of the metal silicon combined with oxygen, is not fuel, but rather a burnt substance which has parted with its heat of combustion ages ago; the second, limestone, being carbonate of lime, or the combination of two substances, viz., calcic oxide and carbonic acid, both of which are essentially products of combustion, the one of the metal calcium, and the other of carbon; and the third magnesia, a combination of oxygen with the metal magnesium, and which, further combined with lime, constitutes dolomite rock, of which the Alps are mainly composed. All the commoner metals, such as iron, zinc, tin, aluminium, sodium, etc., we find in nature in an oxidized or burnt condition; and the only matallic substances that have resisted the intense oxidizing action that must have prevailed at one period of the earth's creation are the so-called precious metals—gold, platinum, iridium, and to some extent also silver and copper. Excepting these, coal alone presents itself as carbon and hydrogen in an unoxidized condition.

"But what about the oceans of water, which have occasionally been cited as representing a vast store of heat-producing power for our use when coal shall be exhausted? Nothing, however, could be more fallacious. When hydrogen burns doubtless a great development of heat ensues, but water is already the result of this combustion (which took place upon our globe before the ocean was formed), and the separation of these two substances would take precisely the same amount of heat as was originally produced in their combustion.

"It will thus be seen that both the solid and fluid constituents of our earth, with the exception of coal, of naphtha (which is a mere modification of coal), and the precious metals, are products of combustion, and, therefore, the very reverse of fuel."

It would be interesting at this time to consider some of the theories of combustion, and also as to how we can best utilize the fuels available; but all this must be omitted, for the present at least, and we must hurry forward to consider the real subject at issue, fuel gas.

Fuel gas, as one of the subjects now before the people, is certainly receiving its full share of public notice and attention. The Associated Press dispatches occasionally report the advent of some new theory and process for generating fuel gas. The local press in many places will now and then give glowing accounts of some new success springing up in their locality. The journals devoted to gas and other manufacturing industries of the country contain, in nearly every issue, some mention pertaining to the development of the fuel gas project. The application and use of natural gas, in some few favored districts as fuel for both domestic and manufacturing purposes, have been the direct means of bringing the subject prominently before the people, and scientists and inventors are not prepared, on so short a notice, to suggest and plan suitable apparatus for furnishing cities and towns with a gaseous fuel, n imitation of nature's own product.

The beauties, convenience, cleanliness and desirability of gas as a fuel for both domestic and manufacturing purposes would tax the talents of a literary person to make a fitting pen picture of the same, so that I will not make the attempt; but I can appreciate the feelings of a person living in a less favored district, when he for the first time witnesses the application of natural gas for fuel purposes, and I am not surprised to find clamors from all sides for a fuel gas. Appreciating these facts, it is not at all surprising that many minds have become interested, and in the excitement have become enthusiasts upon the subject. In fact, to a person not quite so interested, they appear to be nearly beside themselves, so great is their enthusiasm.

We have been told and have read much that has interested and instructed us upon the subject of fuel gas. During some of the sessions of Association meetings, the subject has been quite a prominent feature of the meeting, and at times created quite a lively feeling between various enthusiasts as to what process and what kind of gas was likely to become the future fuel gas, different persons advocating different mixtures as being the correct thing for general use. This leads to the question, What is fuel gas? If the gas is ordinary coal gas, it amounts to a product of the partial decomposition of soft coal by heat. If it is some of the so-called water gas, it amounts to a certain amount of water decomposed into its constituent elements, the oxygen of the water combining with a quantity of carbon, forming carbonic oxide and the hydrogen liberated. If it is producer gas it amounts to the product of a partial combustion in the generator, forming a large volume of gas of low heating value, when volume is considered. To sum up, manufactured fuel gas amounts to the result of the partial combustion of some fuel that nature has provided for man's use. As the hydrogen contained in the element has not combined with the necessary amount of oxygen to form water, nor has the carbon present in the element combined with the necessary amount of oxygen to form carbonic acid, there still remains in the product a quantity of combustible gases. Any one of the above described gases, or any mixture of them may properly be termed a fuel gas.

The most sanguine fuel gas advocate admits on the start that coal gas as ordinarily made is too expensive an article to be used as a common fuel. That water gas is not quite the thing, and that producer gas alone is too poor an article of itself, so that a mixture of two or more of these gases becomes a necessity. I am not prepared to suggest which of these gases, or what combination or mixture of them, would prove the most advantageous to a fuel gas company or their consumers; for, candidly, I am not of the opinion that the proposition as laid down by fuel gas enthusiasts, to-wit, that of converting all of the solid fuel required in any town into gaseous fuel, for all common fuel uses, is a practical one.

Let us now question the origin of the application of a fuel gas. In the early portion of the present century gas seems to have been first employed as a fuel in metallurgical operation. It was employed in the first instance on the continent of Europe. Lampadius, in 1801, was the first to propose the utilization of waste gases, but it appears that it was not until thirty years afterwards that he carried his proposal into practice. In the meantime, Aubertot had employed the waste gases from blast furnaces for several purposes, chiefly metallurgical. These applications did not attract much attention and can hardly be considered otherwise than experimental. In 1837, however, Faber made a reverberatory furnace for puddling pig metal, specially applied to the utilization of the waste gases from blast furnaces, which appears to have had considerable application of a local kind. What was against it was the prejudicial effect on the puddling process, caused by the variation in quality and quantity of the blast furnace gases. This induced Bischoff, a year or two later, to make experiments on the production of gas in a separate producer, and on its after combustion in a special chamber with air. These results were developed to a certain small extent, but it is to the Siemens principle of regenerative gas furnace and producer which may be considered as perhaps the most economical metallurgical furnace.

The first experimental application of regenerators to furnaces was made in 1856, by Frederick Siemens. Numerous improvements have since been made in the detail of construction, the relation in size of generator, and the regenerative furnace used, etc. The regenerative principle of consuming fuel has since that time been applied to other industries than the one in which it originated. Its use is common to-day in nearly all large coal gas works, and the subject has received much attention at the hands of nearly every coal gas engineer.

In a paper read by C.W. Siemens, before the Fellows of the Chemical Society, May, 1868, on "The Regenerative Gas Furnace as Applied to the Manufacturing of Cast Steel," he gave the following description of a regenerative gas furnace:

"The regenerative gas furnace consists of two essential parts, the gas producer, in which the coal or other fuel used is converted into a combustible gas, and the furnace, with its regenerators, or chambers for storing the waste heat of the flame, and giving it up to the incoming air and gas. Any combustible gas might be burned in the regenerative furnace. I have used ordinary lighting gas very successfully on a small laboratory scale, but it is far too costly to be employed in larger furnaces, and the only gas generally available is that generated by the complete volatilization of coal, wood or other fuel, with admission of air in a special gas producer. Any description of carbonaceous matter may be worked in a suitable gas producer, and will afford gas sufficiently good for the supply of even those furnaces in which the highest heat is required. Coal is the fuel chiefly used for gas furnaces in England. Small coke has been employed in some cases, as in gas works, where it is to be had at a cheap rate. Wood is used in France, Bohemia and Spain; sawdust in Sweden, furnishing gas for welding and other high heat furnaces; lignite in various parts of Germany, and peat in Italy and elsewhere, this last being applicable with greatest relative advantage."

The term "fuel gas," then, up to a comparatively recent date, may be considered as meaning simply a more scientific and economic method of consuming a solid fuel, particularly in all cases where an extremely high calorific intensity is demanded; and then only with the aid of the regenerative principle of furnace construction for consuming this gas.

Prior to the more common discovery of natural gas in various parts of our country the number of cases of fuel gas projects as now recommended were very few indeed. As far as I am aware all such enterprises were flat failures.

As previously stated, with the advent of natural gas discovery, the people, aided by and through the press, have steadily demanded some fuel gas process to supply them with a gaseous fuel, in imitation of nature's own product.

Many inventors and others have made response to the common demand, and in the excitement have become very enthusiastic in the claims they make.

In talking with some of these gentlemen it is not uncommon for them to make the claim that with the development of to-day they can take the solid fuel required in a city for all purposes, convert it into fuel gas, furnish fuel for all purposes for which the original solid fuel was intended, and do all this with a fair manufacturers' profit to themselves, and at the same time effect a manifest saving to the consumer of fuel.

The question that then presents itself to existing gas companies is simply this, to wit: Are these gentlemen correct in their statements to us? To a more practical than scientific person the existing data upon this very subject is very perplexing. It seems to determine itself largely upon what the author intends to prove. If he intends to prove that the proposition to furnish fuel gas is a practical one, then he uses a very low percentage for the efficiency of coal, say from 3 to 10 per cent., and a very high percentage for gas. If he is disposed to prove the opposite, then he uses a high percentage for the efficiency of coal, say from 40 to 60 per cent., and a low percentage for gas. Recognizing these facts, the only comparison left for a practical person is to make a comparison between existing fuel gases. From figures now before us, made by scientific persons, I find the following:

Relative Value by Volume.

Natural gas	100
Coal gas	65
Water gas, plain	29
Producer gas	13

In other words, if a man were to pay $1.00 per 1,000 for natural gas, or 65 cents per 1,000 for coal gas, or 29 cents per thousand for plain water gas, or 13 cents per 1,000 for producer gas, it would be an even thing with him, as far as heat units obtained is concerned, no matter which kind of gas he concluded to take.

For some manufacturing purposes in the natural gas districts they are enabled to do the same amount of work with 15,000 cubic feet of natural gas that formerly required one ton of coal; but for domestic uses the natural gas companies claim that not less than 20,000 cubic feet will be required. Now, if 20,000 cubic feet of natural gas is required in practice to do the work of a ton of coal, it would require 66,666 cubic feet of a gas having a heat value of, say, 30 per cent. of that due to natural gas. Such gas at 10 cents per thousand would be equal in cost to hard coal at $6.66 per ton; but were the gas sold at 30 cents per 1,000 the heat bought would be equal to hard coal at $20.00 per ton. Very few would likely buy gas fuel at such a cost.

There are conveniences and labor saving in the use of a gaseous fuel, but the waste of gas from careless use would make the cost of the convenience and labor saving come rather high.

Another favorite claim with the enthusiastic fuel gas man is percentage scheme. They claim that by the expenditure of say from 35 to 45

per cent. of the total efficiency of coal, they can convert it into gas, and in combustion they can obtain 75 to 80 per cent. of the total theoretical heat of this gas; in fine, that by converting the solid fuel into gas, an efficiency of 40 to 45 per cent. of the total theoretical heat of coal may be obtained.

Now my information is, that with a Siemens producer for converting the solid fuel into gas, and with the aid of a regenerator furnace for consuming this gas, and with the further benefit of an extremely high temperature demanded in practice, only from 27½ to 32 per cent. of the total heat of coal is obtained, and yet a fuel gas enthusiast has no difficulty in figuring out that he can easily obtain an efficiency of 40 per cent., and this without the aid of a regenerative principle in the manner of consuming, and the furnace heat only at ordinary required temperatures.

The further claim is made that if gas was only used more commonly for fuel, how cheaply it could be made. The cities of New York, Brooklyn, Philadelphia, Washington, Chicago, and many of our large cities, selling their millions of cubic feet of gas, do not sell their product at lower price per 1,000 than many of the very small towns. Why is it? These large corporations must be growing very rich, or else these little concerns must be running behind terribly, or else some good reason can be assigned.

One of the great items of cost of gas sold, to these large gas companies, is the constant provision necessary to meet the erratic consumption and constant change in quantities demanded, and the great difference in the number of lighting hours between summer and winter months. How would this item appear in the case of a fuel gas company? It would need to be multiplied many times. All of the investment and most of the ground expenses of such a corporation would have to be carried through the summer months with only a comparatively small consumption, and every provision made for the coming winter months and consequent enormous business.

In my opinion the kind of gas to supply consumers for fuel purposes would be an article equal, if not superior in its heating qualities, to the common coal gas now furnished. Such a gas is possible with a carbureted water gas, provided it is carbureted sufficiently. Since it is the carbon only contained in plain water gas that is available for fuel purposes, why not add more carbon to it; in fact load it well up with carbon and make the heat delivery in the first operation, rather than send it out with only the amount of carbon that was required to form carbonic oxide from the oxygen of the water?

It may be that business prudence would dictate the policy of existing gas light companies making special low rates for all power and fuel purposes, having in view the more common use of gaseous fuel for all suitable purposes. Until the time arrives that a sufficient quantity of the kind of gas now furnished consumers for lighting purposes is utilized and required for fuel purposes, the project of a distinctive fuel gas company is fanaticism.

When the time arrives that existing gas light companies find that the demand for their gas for fuel purposes is of sufficient importance and moment as to interfere in the least with their lighting business, or of sufficient magnitude and importance to entitle it to a separate branch of their business, then, and then only, will a distinctively fuel gas project be a commercial requirement and success. I fully appreciate the growing wants and necessities of the common people of the present day. Common folks are demanding for common use, articles that would have been considered great luxuries during the early part of the present century; yet these very people are not blind. All questions submitted them are carefully weighed and balanced. I believe that gas will be more commonly used for domestic fuel purposes. For the present, however, it will only be in cases where heat is required intermittently, but not for heating a man's house throughout, and in all places where heat will be required for 24 hours of each day and every day during the winter months.

There are questions other than fuel gas prominently before the people of this country to-day, and the subject of temperance is one of them. In reading an article upon this subject from the pen of W. S. Searle, M.D., contained in the April number of the *North American Review*, I was strongly reminded of the present position of the typical fuel gas enthusiast. Beginning his article, Dr. S. said:

"Is truth ever a debtor to falsehood? Are reforms ever promoted by exaggeration, misrepresentation, or deliberate untruth? On first thought, no; on reflection, yes. History affirms this, and philosophy explains it. Indeed, no reformation can be cited, whether in law, custom, morals, or religion, which has not been largely indebted to fanatical leaders who, by as much as they were so, were beyond and largely outside of the realm of truth. Free trade had its Cobden, religion its Luther, emancipation its John Brown, and temperance has its Matthew and its Dow.

"Philosophy explains these facts. The inertia of the human mind and soul is immense. Absorbed as men are in the struggle for existence, in the gratification of passion and appetite, in the thousand aims of life, their attention to existing evils can with difficulty be aroused. Still harder is it to initiate reform; harder yet to carry it to a successful issue. Not until a cause finds fanatical advocates who can look but one way, see only one goal, put aside everything, even truth itself, to reach it, and thus arouse discussion and opposition, can a reform make notable progress. And thus truth becomes a debtor to falsehood.

"Rarely, if ever, are these *avant couriers* right, either in the principles they advocate, or in the means they employ to establish them. In time, the world moves forward toward them; sometimes to one or the other side of them: perhaps even beyond them. But if it ever occupies their ground, it is not for their reasons. Such men are as narrow in their views as they are intense in their purposes. Like red-hot pokers, they burn their way where broader natures would fail to penetrate. But the holes they make are small. Still, when their cause is good, we must applaud them for the results which, without their aid, would fail of accomplishment.

"It is thus we regard those who would rally the world to temperance reform under the banners of total abstinence. They are fighting a hideous evil, they are leading the 'forlorn hope' in conflict with it, and, for the sake of the good which has come and is to come from their efforts, we accord them hearty applause, and cordially second their aims. But yet temperance is the true doctrine, and total abstinence is fanatical error."

Likewise, then, the more common use of gas for fuel purposes is the true doctrine; but fuel gas as at present presented by the fuel gas enthusiast is fanatical error.

Discussion.

Mr. Smedberg—I would like to ask Mr. Faben where he finds warrant for the statement that "It is the carbon only contained in plain water gas that is available for fuel purposes."

Mr. Faben—My information is, in estimating the available heat of a fuel, that if the fuel contains carbon, hydrogen and oxygen, the only hydrogen that can be counted as available for rendering heat is that quantity of hydrogen present in excess of the amount of oxygen present in the fuel to form water. As I understand it, the purpose of all the men who are making water gas—at least they say so to me, and I am making water gas—is to make carbonic oxide of all the oxygen contained in the water employed. Now, if I have so far succeeded in making carbonic oxide from the oxygen present in the water, and liberating hydrogen, I simply get the heat which is due to the quantity of hydrogen contained in the water, and of the carbon present necessary to make the water. I do not take any extraneous oxygen, for I have got the oxygen already in my fuel. So I contend that the only fuel present in plain water gas would be the carbon.

Mr. Smedberg—In the first place, water gas made from anthracite carries about 7 per cent. (by weight) of hydrogen, or close to 50 per cent. of hydrogen. The water gas made from bituminous coal, carries 13 per cent. free of disposable hydrogen—you get a liberal dose of pure coal gas, and you get a liberal dose of carbonic oxide. In other words, as I understand Mr. Faben's position, it is that the only value of a fuel gas depends upon the amount of carbonic oxide which it contains.

Mr. Faben—That is all qualified in the paper, which you will see if you read it closely. You will notice that I said, "In plain water gas." I did not say carbureted hydrogen, or light carbonized hydrogen.

Mr. Smedberg—From hard coal?

Mr. Faben—I do not say that. I said "plain water gas;" any fixed carbon may make it.

Mr. Smedberg—It is a new proposition that all the hydrogen contained in uncarbureted water gas is of no use to heat a kettle of fish with.

Mr. Faben—In other words, we take a pound of water, decompose it with fixed carbons, and get, approximately, say 21 feet of hydrogen and 21 feet of carbonic oxide. Now I say that the combustion of that 21 feet of hydrogen—in being burned to water, and the carbon of the carbonic oxide—does not render any heat available in combustion.

Mr. Smedberg—Exactly.

Mr. Faben—And that there is not heat enough in the fuel to combine with that hydrogen and form water.

Mr. Boardman—I think you are probably misleading some by your statement. As I understand it, the heat which you are using as the available fuel is the carbon carried by this gas; whereas the heat formed by the re-combination of the oxygen, which is carried by the gas as carbonic oxide and the hydrogen, is not available for heat. I think

probably you are in error there, and for this reason. While we do not gain anything over the heat that we have been using in decomposing that, and while we gain nothing over that by the re-combination of the oxygen and hydrogen, still, as we effect that re-combination in a different place, the heat eliminated from that, or the heat which is in the hydrogen and the oxygen, separated as they are, is available at that point. It was used in separating them at the factory, and it can be used again when they are re-combined at another point, and is therefore utilized at that point. In other words, I do not think that it will take quite as much heat; and perhaps I might add that I hardly know how to explain my idea there. The carbon, of course, is carried along in the gas, and is made more easily and used as a fuel by being carried in an aqueous state. That we can understand. But your idea, as I understand it, is that the re-combination of the oxygen and the hydrogen in the water takes away as much heat, or only gives the carbon the heat that it would have in its combustion. I claim that the heat you have expended in the manufacture of that is carried to this further point, and that you are able to utilize it at this point—not that you gain any heat, but that you simply transport it.

Mr. Faben—As I understand the matter, to burn carbonic oxide to carbonic acid in ordinary atmoshere, and to make the combustion perfect, would require the presence of about one-third of its volume of hydrogen. So that the heat of combustion of a different quantity of plain water gas could not amount to more than the total theoretical heat of the carbon contained in the gas. There is no question because of the presence of that hydrogen and oxygen in the fuel, and the combustion taking place within the body of the flame, but what the combustion of carbon is promoted so that it does burn it to carbonic acid. But the total heat resulting from the combustion of plain water gas never amounts to more than the total theoretical heat of the carbon contained in it.

Mr. King—When we get our school established for educating gas engineers—which was talked of this morning—we can properly consider and discuss the combinations which go into these gases. I think the subject has been fairly discussed in the papers which have been read before the Association; but as far as I am concerned (and I assume it is the same with a great many others here) what we want to know more about of this question is the practical part of it—will it pay? Are we ready to go into it? Has there been enough developed on the practical side of this matter? I have never doubted that a gas could be made which would be a good fuel gas and could be used; and I know that fuel gases are now used in local plants under local conditions. But, for general distribution can it be done at a price that shall deliver heat units to the consumer that will be sufficiently satisfactory to do his work, and also prove remunerative to the gas company. A year ago I was a great deal more enthusiastic on this subject than I am now. I hoped then, and I hope now, that the problem will be solved; but the more I go into it the more I am compelled to accept Mr. Faben's conclusion. The matter of distribution is a serious thing. Can we do it at a price that will be remunerative? I made a few figures based on a discussion at the Ohio meeting. In a paper read there the capacity as stated (I think 500,000 cu. ft. per day) would involve an expenditure for plant of $150,000. I confess that I intended to give this more thought, and to go into the figures more in detail than I have—but I assume that if we give them for six months in the year full consumption it would be fair to give them for the other half of the year one-quarter consumption. That is, in the winter time they are running to the full capacity of their plant, when they are doing their heating (and I assume that that is what they are trying to do—to do not only cooking but heating), and that in the summer time it would be only fair to take the other six months at one quarter. I believe that I figured five per cent. as the average loss by leakage and condensation. On that basis it would cost 13 cents per 1,000 ft. in order to pay ten per cent. on the capital invested—$150,000. The author admitted that his gas might cost him ten cents per 1,000 in the holder. I do not know how he figured that—whether it included superintendent's salary, and wear and tear, or not. That would be 23 cents per 1,000. He is selling it at 30 cents per 1,000. Can you pay your office expenses, keep your meters repaired, pay for all your wear and tear and taxes, and everything that goes into the business, with 7 cents per 1,000? I do not believe it. At least, I cannot figure it in that way. I would like to hear a discussion on some of the practical features; but to my mind the most serious difficulty in the whole question is that of distribution.

Mr. Egner—We practically get out of coal, if we convert it into gas and into grains of sperm, 480 grains of 16-candle gas. If we convert it into electricity we get 100 times as much by the arc light, and 12 times as much by the incandescent system. That is practice and theory combined. You can easily figure it out. I have experience with both coal and water gas, and know what I can get out of the coal—as for the electricity I have to take that on the reports of other people. But that is what we get. We get 480 grains sperm out of coal alone, used as gas; and we get so many more grains if we convert it into arc light, and 12 times as much if we convert it into electric incandescent light. It does not matter to us whether the gas is used in the burner or in the gas engine. We are not getting out of the coal now what there is in it. That is the simple fact.

Mr. Page—These are certainly two of the most interesting papers that have been prepared and presented to the Western Gas Association. The first one relates to a living question, which interests every gas maker and every gas consumer. If incandescent lighting be what it has been heralded by those who have favored it, or been interested in it commercially or financially, why, then, it is what every gas maker wants. Perhaps a little personal experience with regard to this matter may be interesting. In 1882 I saw, I think, what was supposed to be the first practical incandescent gas burner in London—the Lewis platinum. I went a long distance to see it. I thought that even that would be profitable, and that it would be a success. It certainly looked to be so—it was a beautiful light, steady, and without a flicker. The London Gas Light Company wanted to burn it, because of the saving to be made in the consumption. To-day the Lewis incandescent is the Sellon, and the wealthiest dealers in platinum have taken up the thing for two years past and endeavored to make a success of it. But I question whether they will. The next one to come before us on the other side was the magnesium comb. That was beautiful. It was attractive. It was supposed to be economical, but did no prove to be so. It was fragile. It would break when you looked at it. It was a failure, notwithstanding it is being advocated in some parts of the country to-day. It cannot be successful unless there are some very large changes, both mechanical and chemical. The next was the Lowe. Notwithstanding the special train to Baltimore to see the successful installation of the Lowe incandescent gas lamp, or gas burner, which was to revolutionize gas burning and reduce the cost to the consumer 25 cents or 50 cents per 1,000—Lowe, the conquering hero, still remains somewhere near the back door. The burner is not a success. Then, the Welsbach. I suppose that there never was another invention brought to the United States that has had as much money expended upon it, that has been so thoroughly backed up. There have been connected with it the wealthiest men of the United States—millionaires; for there was rarely a man mentioned as identified with the enterprise, or in the Board, who was not a millionaire many times. The lamp was put upon the market without limit as to cost. That is, it seems to me that when millions are in question, millions must have been paid. (I have not been entirely through the figures), but I assume the companies organized represent over a hundred millions. And yet that invention, introduced first in the Vienna post office by its inventor (Dr. Welsbach von Auer), is not a success in Vienna. It is not a success in Paris. It is not a success in London, where gas is selling at half the price it averages in the United States, and where there is just as great a demand for cheaper gas as there is here—in fact a greater demand for cheaper gas than here, because the people who burn it there average less per capita of wealth than in our country. You see that lately the Philadelphia local company has disbanded. Just a year ago at this time the London parent company paid back, or rather the parties from whom the patents were bought paid back to the London local company £210,000 in cash and stock which was given for the patents. I wish it might be a success; but it is my opinion that a burner that requires the constant care of an expert to look after it cannot be taken by common people, nor by people generally. Who cares for the gas burner? I make the statement that these burners in this room have probably been in use for the last 15 years. Five or ten cents would replace them, and then they would give from 25 to 50 per cent. more light. Why don't the owner of the house do it? You would think that a man who is consuming gas and paying gas bills would attend to it. Why don't the gas company do it? They don't even do it when you want them to. Who will pay $2.50 for a gas burner, even if it is cared for by the company? It is too expensive. You must furnish burners for nothing. Gas companies will come to that, and ought to do it now. So I question whether the sucful incandescent gas burner has come yet. It will come bye-and-bye. At the same time in London I saw the Grimston—the original regenerative gas burner. From a comparison of the two I thought that the incandescent would be the one that would take. To-day we see not only the Grimston but also the Bower, the Chandler, the Schulke, the Wenham, the Sugg, and half a dozen others, selling to the extent of hundreds of thousands per annum. In this country, take the Lungren. Can you go anywhere without seeing the Lungren? Can you go any-

where in this town and see the Welsbach? That seems to be practically set aside. The regenerative gas burner has come to stay. It will be displaced bye-and-bye, perhaps, by an incandescent, but not yet. Now, what about fuel gas? That paper of Mr. Faben's is one that seems to me to cover the question fully and completely. It is a question which is not new. The *Journal of Gas Lighting*, of London, and the *Journal des Usines a Gaz* have been full of fuel gas for the last 25 years. In 1870, the first time I was in England, they were demanding fuel gas. Fuel gas when sold must be distributed in the same mains through which coal gas is being distributed. That is the decision of Livesey, of Hunt, of Spice, of King, of England, of Ellissen, of Paris, and of Schilling, of Munich. Now, we have come to the point, with all due respect, of course, I say it, where the real estate man's dollar, or the dollar of the dry goods man, or the dollar of the boot and shoe dealer, or of the men from those walks of life who have had no practical experience in gas making—where these people—the fuel gas experts and promoters of to-day say, "I am going to displace all your illuminating gas business here with fuel gas." The capitalist don't know and he buys—promises never to be fulfilled. And to-day Burdett Loomis has a company organized in London for the purpose of exploiting his fuel gas in that country. I saw, not long ago, in the Victoria Hotel in New York, a whole side of the London *Times* taken up with a water gas advertisement, and it read like some of them that I had seen in this country. Capitalists talk of water gas on the other side, but there is no chance for water gas to get in its work there. Why? Because with 40 or 60 cent gas they cannot show enough difference in cost. As between that and gas at $1.25, $1.50, or $1.75 in this country they might. Therefore, they simply will take in the investor—as the electric light men from the United States and Europe took in the electric light investors in London, in 1882. I did not intend to take up so much time as this, but I think the time has not yet arrived when fuel gas can be put on the market successfully. It will be done before many years by the existing gas companies. Why? Because the cost of gas is being steadily reduced. It must be by the reduction of the cost of gas in the holder, and not by the cost of gas in the distribution. You cannot reduce the latter much. It must be done either through special economies of financial management, or in the care taken to stop leakages, and by very greatly increasing the sendout. So that, when the price of gas in the holder comes down to *nil*, as it has in one city in the United States; then—fuel gas. (Applause.)

The President—Mr. Cowdery has had some experience in fuel gas, and we would like to hear from him.

Mr. Cowdery—I do not think I can give you any information on this subject. I think what we most want to know to-day is what the consumer can afford to pay for any particular kind of gas, as compared with coal. I was in Jackson, Mich., recently, looking into the fuel gas question, and I asked Mr. Evans of that city what the gas could be distributed for. He told me that we could take 7 cents as the cost of distribution. Now we want to know whether that is correct or not. The people figure in this way—that the gas used in the ordinary street main, if burned for fuel purposes, would be used every hour during the 24 hours of the day, in somewhere near equal quantities; whereas at present the gas is only used about 6 hours out of the 24. In that way we might cut in two the cost of distribution as it is at present. Also, the number of consumers would be lessened for the same amount of gas. That might lessen the cost of distribution. It is, therefore, barely possible that his cost of 7 cents for distribution is correct. Before we determine whether we can afford to distribute gas at any figure that the consumer can afford to pay we have to know, first, what the consumer can afford to pay.

Mr. King—In that case would you not have to increase the size of the mains; and would not the cost of the plant be increased, and so off-set some of these other reductions?

Mr. Cowdery—You would have to increase the size of the mains, naturally; but not in this case. That is, if you send out three or four times as much gas through the same mains in 24 hours, naturally the cost of distribution would be cut in two; would it not?

Mr. King—You would reach your maximum in certain hours; and as fuel gases are all heavier, not of lower specific gravity, than illuminating gas, you would have to enlarge your mains to accommodate that maximum, or else increase your pressure. Would you not thereby increase the cost of distribution?

Mr. Cowdery—I am not designating any particular kind of gas, only *some* fuel gas. If we can distribute one kind of fuel gas for 7 cents per thousand, can we not distribute some other kind at somewhere near the same price? If it is heavier, it will be at a little higher cost. The only thing that I would say on the subject is this: If you can distribute gas at 7 cents per thousand, it is barely possible that we can make and distribute gas at a cost that the people can afford to pay for it. I do not say that we can, but that it is barely possible.

Mr. Faben—I think in the incandescent lighting business some merit presents itself that has not yet been mentioned; at least I have not heard it mentioned. The regenerative burner certainly makes too much heat, a plain flame burner makes considerable heat, and an incandescent burner certainly does not give the amount of light that the ordinary plain flame does. To reduce an incandescent burner would reduce the amount of heat and change the color of the light; but by doubling up the number of burners an equal amount of light could be obtained. I think that improvements have been made in incandescent burners in the last year—some of them very marked; and I think the developments that have been made with them, and those that are likely to be made shortly, that gas companies cannot afford to believe that the Welsbach incandescent lamp on the market of to-day, being a complete failure, must be left alone. It is true that not many are in use, but it is equally true that it has been only of recent date that the company making them have made much effort to establish them commercially.

The President—If Mr. Eaton, of Jackson, Mich., is in the room, he can probably give us some experience in this matter.

Mr. Eaton—My experience is with coal gas. My competitor is the man who sells the fuel gas; and as Mr. Evans is not here I do not think that any of my experience as to his business would be beneficial. (Laughter.) My opinion is that coal gas is good enough for my company yet a while.

Mr. Somerville—One fact that I have observed about the distribution of fuel gas may perhaps give food for thought. As you know, we have had a very mild winter—exceptionally so; and the natural gas suppliers in Indianapolis carried a pressure of from 20 to 25 pounds to the square inch. When the temperature went down to perhaps 20° or 15°, as it did for a little while, that pressure would diminish to about 10 pounds to the square inch. On one day last winter the mercury fell nearly to zero, and remained there for four or five hours. Then that high pressure disappeared completely, and I had not a pound at my works; and other companies had none. So, gentlemen, in talking about fuel gas, if you want to lay out a plant I gather this from the facts: In laying out a plant for fuel gas, if you calculate that a consumer would burn 50,000 feet per month, my advice would be to call it 100,000 feet per month, and to make provision for that. As to incandescent lights. What Mr. Page said about the Welsbach burner would apply to coal gas. We have it there in our city, using natural gas. We claim that natural gas does best. Well, with a 2 or 3 or 5 foot burner, the Welsbach certainly gives a pretty light, and an abundance of light, running on natural gas. If you are careful to renew the mantles every two or three weeks you will continue to have first-class light. And at 15 cents per month for the gas they don't mind a little trouble about the chimneys breaking, or renewing the mantles, when they can get the gas. So that I would not condemn in toto the incandescent light.

Mr. Smedberg—May I ask Mr. Cowdery one question? As I understand his drift it is that if we can send out coal gas at a uniform pressure throughout the 24 hours, our cost of distribution will be so much reduced per thousand feet that we then bring legitimate lighting coal gas within the purview of the term fuel gas. That is your proposition, is it not?

Mr. Cowdery—Yes.

Mr. King—I do not know that I make myself clear, but what I want to explain is that, so far as my conclusions reach, they are in the line that it will be coal gas that will be used for fuel, to a certain extent. I do not believe we could get into it to the extent hoped for by the fuel gas people. There is one point that I want to make inquiry about. From Philadelphia we have the word that they are getting their fuel, or are going to, for almost nothing; in fact, that they are burning air there. It is said that all you have to do is to start the fire, and it will burn on indefinitely. It is true that we have an unknown name in connection with that matter; and there is not very much comfort, if any, for coal gas or fuel gas men in that suggestion so far as heating or cooking is concerned. I would like to ask about that. Have any of our Philadelphia friends seen the process?

The President—Perhaps Mr. Graeff can tell us about it.

Mr. Graeff—I do not think there is any process in Philadelphia or anywhere else by which air is being burned without expense; but there is at Philadelphia a gentleman who has devised a new style of grate by which he secures a decided gain in the combustion of his coal. It is a matter which has been going the rounds of the technical papers throughout the country. I cannot describe it half as well as Mr. Smedberg can, because he is the man who induced me to go and see it. As I saw it, it was simply a portable heater, apparently. Well, it really was a port-

able heater, of the ordinary size, within which was placed a grate in the shape of an inverted hat. The bottom of the hat was the grate, and the sides were hollow, and around the edge or rim of the hat spread out something resembling fingers. This grate was filled with hard coal, on top of which was placed bituminous coal; above this the man placed ordinary kindling lighters, and it was fired on top of this kindling. In a remarkably short time the heat developed to an extent that the drum of this portable heater became a cherry red. The draught was downward from the chimney. I saw that heater burning there at a tremendous heat for a space of probably more than two hours, with a remarkably small combustion of coal. I presume that in the heater there was placed probably from 50 to 60 pounds of coal, and I am satisfied that at the end of two hours run the coal that could have been taken out at that time would have weighed—I think I am safe in saying, within 20 per cent. of the weight that was originally placed. I think that what is contained in that invention (whatever it may be termed) arises from the simple fact that instead of utilizing a small portion of the combustible elements of the coal and passing the rest up the chimney, the greater quantity is utilized and a very small percentage goes up the chimney. As regards the other claim made for it, I have nothing to say. I think that very frequently inventors make claims which practical men cannot see through. Mr. Smedberg induced me to go and see this, and as he is a practical gas engineer of long standing I think he can explain the phenomenon, if there be any phenomenon connected with it.

Mr. Smedberg—In justification of myself it is proper to say that it was by the merest accident I went to see this Phails heater—which is the name of it. There are certain phenomena there which the inventor himself does not understand, and does not pretend to explain. When I went into the room there were present delegates from 20 of the big iron works and establishments of Pittsburg. After seeing it I mentioned the thing to Mr. Graeff, and he had been so perplexed by the representations of a man named Blodget (not our Blodget, but another Blodget) that he finally went to see it; and he was just about as much stupefied by it as myself.

Mr. Graeff—No, Mr. Smedberg; I was not stupefied. (Laughter.)

Mr. Smedberg—He was stupefied; but perhaps he has recovered. However, all the phenomena that he has given you are stated correctly, but he has forgotten two points. From a small aperture of a certain size, at the bottom of the draught door, a roar goes out that shakes that whole building. You can hear it two blocks away. You can feel the vibration. What there is inside of it I do not know; but there is that vibration and that noise. When the aperture is closed that uproar gradually ceases. In the next place, a gentleman from the Vulcan Forge Company and myself walked up to the opening which had been left in the up-take flue, and found that it was covered by an ordinary tin cover, and that was on it at the time that the uproar was going on. When it was shut that downward blast stopped. I want now to tell you what happened with regard to Mr. Phails. He was the inventor. He got up and made quite a long speech. He said that a Greek philosopher (Thales) discovered electricity, and that electricity comes out of the air; but, said he, "Who can tell us what electricity is? Now," said he, "in that up-take there are two draughts—the hot air going up, and the cold air coming down; and my own way of accounting for this pressure is that there are four elements in air—the ordinary oxygen, the ordinary nitrogen, the accidental electricity, and the consuming element." With that I am done. It confused my friend Graeff and myself; and now you know as much about it as we do, and as much as Phails himself knows about it.

The President—Before closing the discussion on fuel gas we would like to hear from Mr. McMillin.

Mr. McMillin—Mr. President, I have been wondering since I sat here if I was not about ten years younger than I used to be. I think I have gone back about ten years to-day. A man who can get up here and will in the most emphatic manner condemn those that may have advanced ideas, and that are not afraid to put them forth for the benefit of his fellow men, receives the heartiest applause of the Association. I am always glad to hear my friend get applause. He deserves it. But I am sorry indeed to see that we are so unanimous against the idea that we have fuel gas, or likely ever will have it. It was not my intention until the last moment to say a word upon this subject. I hardly think it worth while to answer assertions at any time, and I do not find that Mr. Faben presents any figures here that give one an opportunity to combat them. He asserts that anyone who believes that fuel gas is a possibility is fallacious in his ideas—that it is fanaticism, that it is a falsification of the truth, and all that sort of thing. Now, I do not think so at all. I believe that fuel gas is possible. I believe we will all have it in our works after a while. Of course, I feel myself classed with the fanatics; and if to believe in such things is fanaticism, then I am proud of the appellation. (Applause.) I think that Loomis, Clark, Lowe and a few more of us will be able to stand the appellation. I am willing to be classed along with any gentleman who advocates the possibility of fuel gas. It is the easiest thing in the world to be mistaken, as my wife often tells me. If it was not a breach of confidence I would like to tell you of a little incident that occurred up at the Ohio Association in Sandusky, when my friend Faben related to King, myself and others of us a process for the manufacture of gas which he knew was all right. (Laughter.) Now, should I get this wrong I hope Faben will correct me, and I will take it all back. It is pretty hard work to tell the truth, even when a thing is fresh, and this was so long ago that perhaps I may exaggerate. My recollection is that he knew that that was all right because he saw it. And he had us considerably worked up about it for some time, or until we got to figuring on the thing, when we found out that the gas weighed three times as much as the material it was made out of. Then he claimed that there was some mistake about it. I mention this to show that even he may be mistaken about the impossibilities of manufacturing fuel gas. I shall not go into the details, because his paper is before us, and I am not trying to do more than to answer the general assertion. I will simply mention the fact, however, that where fuel gas is used—as, for instance, where our President referred in his address to day—in rolling mills, where the fuel gas takes the place of solid fuel, any of us who have had experience in either business recognizes that as nothing new. That has been done for a good many years. It is one argument in favor of the idea that you can supplant in a whole city solid fuel by gaseous fuel. I am one of the parties who believe that it can be done. I believe that if the Cincinnati Gas Company to-day had their apparatus ready, and if the people with one accord would agree to burn fuel gas, that they could make it and sell it cheap enough so that consumers could afford to burn it; and they would make it all coal gas, too. I am not an advocate of producer gas, nor of water gas, nor of mixed gas, nor of any other gas, except as to locality. There are places where producer gas would be the best—as it is in a rolling mill; where the cheapest gas you can manufacture is the producer gas. In every other place perhaps the best and cheapest gas you can manufacture is the water gas. In Cincinnati it is coal gas. In some other places it would be a mixture. But I know that to-day 300 or 400 pounds of slack is substituted in many rolling mills for 200 or 300 pounds of lump coal, simply by converting their fuel into gas, and that with the addition of the regenerative furnace; because the latter, after all, is a good thing. There is no reason why it should not be adopted however in all the processes. The question of distribution has been discussed at some length. A great deal of stress has been laid upon the fact that you could not possibly distribute gas cheap enough so as to be able to sell it. Now, I assume that the gentlemen who make those assertions have not carefully figured it. I know that each and all of them are competent to figure it out, but I believe they would not make the assertion if they had figured it. That gas can be distributed now for 7 cents I think can be proven, and not go very far to do it. Now, suppose you were sending out 100,000,000 feet, or, to get down to a smaller figure than that, suppose that you were sending out 10,000,000 feet per day, and you have a million feet of leakage. You are sending that out now principally during three or four hours. Now, if you were sending out pretty uniformly during the day, as you would with fuel gas, you would send out 50,000,000 feet of gas. How much would you cut down your leakage—in proportion to the send out of 50,000,000? Of course, you must largely increase your pressure, or put down larger mains; and if you are doing a large business you can very easily put down larger mains. But even at the same time if you increase the pressure you increase the leakage in proportion to the increase of pressure, under a rule well known to all of you. But, it would be utterly insignificant. What was before 10 per cent. of leakage would possibly be 1 per cent. How is it with each one of you at his works? Does any man in this room pay half as much during the winter quarter as in the summer quarter for distributing gas? Why? Because the send-out is twice as much in the winter months. It is just about an even figure with us. Our quarters begin on the first of January, the first of April, the first of July, and the first of October. From the first of October to the first of April each of those two quarters will not vary a half cent per thousand on the cost of distribution; and each of the other two quarters will not vary half a cent per thousand; but it will be just twice what it was during the other two quarters. Now, if I can cut down the cost of distribution one-half by doubling the consumption, then by multiplying my consumption by 10, what do I do? You make it utterly insignificant. The cost of distribution is a very small one; and if you make your gas cheap enough you can get it to the con-

sumer. Yet really, until I heard friend Faben's paper, I was not aware that I was an enthusiast; but I am satisfied I am now—more of an enthusiast now than I was before. If I had been more of an enthusiast, and had had control of a little more money in the last year or two, I might have done something. I don't understand why I have not spent more money; but I have not. I have not spent any of my own money at all. I have advised with other people, and have got them to spend some. (Laughter). I shall continue to do that until there are better processes for manufacturing fuel gas than there are now. (Applause). I am not a real enthusiast, as you see, after all. I think some other fellow will get it. I don't expect to do it. But I am going to help him all I can.

Mr. Scofield—By letting him pay the expenses?

Mr. McMillin—Certainly. I question if Mr. Faben has had the opportunity for knowing the cost of fuel gas experiments that I have had. I have been associated with men for about 30 years who have spent thousands and tens of thousands of dollars; so that I am tolerably familiar with what these things cost. If it were merely a question of the cost to manufacture, or even a question of the cost of distribution, I think the problem would be solved. But the question is not one of scientific or of mechanical success; it is one of commercial success. You have to educate your consumers up to using it. Each consumer does just what I have been practicing. He is waiting for the other fellow; and they are not all going to get at it at one time. The first men who go into the business will lose money; but they will gradually get there—just as gas for illuminating purposes has gone down from $5 to $1, and will go to 50 cents after a while. And so it will be just that way with fuel gas, or there must be something or other to induce people to use it at high prices. When they quit using natural gas, because they cannot get it, then they will be willing to pay a pretty high price for a very much poorer gas, rather than go back to solid fuel. And the gas companies will furnish it. And they will come together just as they have upon the lighting gas question. More consumers will use it, and the more consumers there are the more the reduction will be; so that after a while it will get down to a low point. But it will not come in the next year or two by any means.

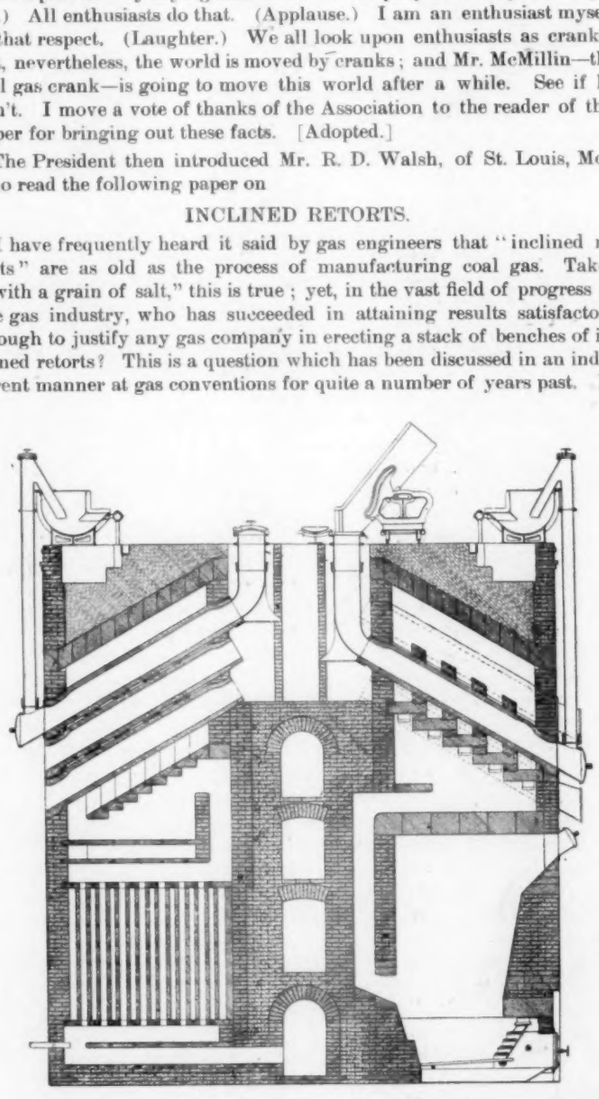
Mr. Faben—Mr. President and Mr. McMillin: What I said in the paper with reference to enthusiasts did not apply to Mr. McMillin, or, personally, to anybody here. One has simply to read the manufacturing papers of the country or the Associated Press dispatches for reports of performances of that kind, to find where the people are enthusiastic, and who are enthusiasts. I wish I had with me a paper which was read before the Medical Society, of Toledo, on fuel gas. If it would not appall you I shall miss my guess. What I said at Sandusky last year to Mr. King (and not directly to Mr. McMillin) was to describe the theory of the Hall—afterwards known as the Proctor process; the theory, not my belief, but that man's theory. I said I did not endorse the principle; for no man could endorse it. I simply stated what his theory was, which was a most beautiful one, and which would have been correct had it only panned out in practice. I did not say it would pan out in practice; for I did not believe that it would. In fact, no sane person would believe it. I am utterly surprised that Mr. McMillin would stand before this Association and say that I had endorsed a statement of that theory. I did not do anything of the sort. Anyone who has asked me about Mr. Hall or his adopted daughter, Miss Proctor, or the rest of the "outfit," knows that I never endorsed them. Mr. McMillin has assented to the claim I made. I do not say, I do not claim in the paper, and could not stand here before an assemblage of intelligent people to tell them that the project of a fuel gas plant would never be accomplished. I did not say it—I said "for the present." Until the time comes when the demand for fuel gas is of great enough importance to cut a figure in a gas company's business, not until then will a distinctly fuel gas project be a commercial project. I believe that gas will be more commonly used, and that when that time comes it will be cheaper. It will cheapen all the while. Its price will be reduced. I never made a fuel gas experiment. I confess that bluntly. I will qualify the remark which I have made by further saying that it would be pretty difficult for a practical person to judge of the importance of fuel gas from the statements that are made, for these seemingly depend entirely upon what the authors intend to prove. I did not figure them out, or attempt to digest them, or anything of that sort. I find that Mr. McMillin showed in his paper about the percentage of saving that would be effected by making a mixed gas, through improvement in combustion, etc., and I also found in a recent issue of a technical paper an article on a foreign water gas process, where one authority shows because of the products of combustion escaping up the chimney at one temperature, water gas is better than producer gas; but if taken at another temperature the reverse is the case. Those gentlemen are all a long way apart. One disputant makes his figures so as to show that the calorific effect of a pound of coal is under-estimated, and that the efficiency is over-estimated; but he must make those "corrections" in order to cause his figures to pan out. I have no object in correcting that man's figures. I must take the figures just as they are presented to me. How largely or how varied Mr. McMillin's experiments on fuel gas have been, I know not. He has never told me; nor has he had an object in telling me, nor in asking for my opinion; nor I his. Hence I cannot understand why Mr. McMillin got up to talk about a theory that I told him of at Columbus—and to say that I singled him out of this Convention as the only enthusiast! I did not do it, and I did not intend to.

Mr. Boardman—I think Mr. Faben's paper has drawn out the fact (that we all ought to take cognizance of) that Mr. McMillin has out of his own mouth proved that he is an enthusiast. He says that he is, and he proved it by saying that he uses other people's money. (Laughter.) All enthusiasts do that. (Applause.) I am an enthusiast myself in that respect. (Laughter.) We all look upon enthusiasts as cranks; but, nevertheless, the world is moved by cranks; and Mr. McMillin—the fuel gas crank—is going to move this world after a while. See if he don't. I move a vote of thanks of the Association to the reader of this paper for bringing out these facts. [Adopted.]

The President then introduced Mr. R. D. Walsh, of St. Louis, Mo., who read the following paper on

INCLINED RETORTS.

I have frequently heard it said by gas engineers that "inclined retorts" are as old as the process of manufacturing coal gas. Taken "with a grain of salt," this is true; yet, in the vast field of progress in the gas industry, who has succeeded in attaining results satisfactory enough to justify any gas company in erecting a stack of benches of inclined retorts? This is a question which has been discussed in an indifferent manner at gas conventions for quite a number of years past. In



matters of commercial activity, of progress in the arts and sciences, of inventive faculties and genius, the Americans hold themselves, and justly, too, second to no other nationality. We are proud to boast to-day of a set of gas engineers from Hudson bay to the gulf of Mexico, and from Queen Ann's harbor to the golden gates of the West, who will, in intelligence, enterprise, thrift and progressive genius, equal that of any other nation on the face of the globe. This is no idle boast. Young as I am in the profession which I have chosen, I see around me, and I have met in other countries than our own, gas men who could command the respect and admiration, not only of their subordinates, but of every one with whom they came in contact. This has been evidenced by the installation into membership of the leading gas institute of our so-called mother country of two of the most eminent and distinguished members

of the Western Gas Association. The gas interests of this country are, and must be identified to a certain extent with those of foreign countries. The improvements they make in manufacture and distribution must, through the mighty agency of the press, redound to our benefit; while those which we make, skeptical as they are abroad of anything American, are eagerly taken up and turned to profit by those who have imbibed our spirit of progress.

And so, with this brief preface, and conscious of any infringement which may be made upon our native-born rights to have an alien and a foreigner claim that he has circumvented some of our best gas engineers in the construction of a bench of "inclined retorts," superior to any yet known to them, I return to the subject of my remarks.

About two years ago, while abroad, I met by appointment, at Paris, France, M. Andre Coze, superintendent and director of the gas works at Rheims, France. In his company I visited the works at Rheims, where he had in operation at the time a bench of nine retorts, with a regenerative furnace constructed after his own plans and designs. The retorts were inclined at an angle of 30°, and charged from above or at the rear, by means of a wagonnette consisting of three coffers mounted on a truck, which could be run along a track on the top of the bench, so as to bring the mouths of the coffers directly above the charging mouths of the retorts. The coffers, when filled with coal, are horizontal, but by means of a lever and catch attached to each they may be thrown down at an angle of 30°, and thus discharge their contents into the retorts.

The method is so simple and the operation so quick and effective, that it must immediately recommend itself to any one who sees it. This in my opinion is one of the best features of M. Coze's system, as it requires no skilled labor to handle the wagonnette; the charge is made in half a minute at the most, and there is scarcely any loss of gas while it is being done.

One formidable objection which I naturally thought presented itself to this method of charging, was that the coal would choke up at the lower end of the retort, and there would not be an even distribution throughout its length.

M. Coze had three retorts charged in my presence and soon convinced me that this was not the case. Upon opening the mouthpieces below, after the charge had been made, I looked up the inclined surface of each retort and found the coal evenly distributed along its entire surface to the iron elbows which carry them to one level at the top of the bench. Having been pleased with its workings, and thinking M. Coze had made an advance in the right direction in the manufacture of coal gas, I made arrangements with him to construct a bench of his retorts at our works.

The retorts, mouthpieces, iron elbows, wagonnette, etc., were all made in France, and by the consent of Mr. Socrates Newman, who was then President of the St. Louis Gas Light Company, a bench of five retorts was erected at our works.

I know no better way of giving you the results obtained from this bench than by reading you a letter written by Mr. John B. Taylor, our engineer, who has carefully observed its workings, and is well qualified to speak on the subject:

"St. Louis Mo., April 11, 1889.

"*R. D. Walsh, Esq.:—Dear Sir:*—In reply to your inquiry as to the results obtained from operating the bench of inclined retorts—Coze's patent—in these works, I would state as follows: The bench containing 5 retorts has been in constant use since May 1, 1888. The retorts are from France, and contain a considerable quantity of silicate, but whether mixed originally with the clay as found there, or added to the same in the manufacture of the retorts, I am not informed.

"The retorts are 15 by 23 inches by 11¼ feet, to which length is added the mouthpiece with self-sealing lid in front, and a cast iron elbow attached to the rear end, to receive the vertical feed hopper, which also has a self sealing lid. The bench is set with the common grate furnace, 14 inches wide by 5 feet in depth. The front of the arch is 10 feet 9 inches across, and height of stack 16 feet 2 inches from top of ashpan, and 13 feet 5 inches long, supported, and *well* supported, by old steel rails as buckstaves. The chimney flues are 14 inches and carried through the roof (the bench being set in a frame shed) by means of two 11-inch boiler iron stacks, which create so great a draft that the damper tiles are shoved back to within 2 inches of the back of the flues. A 12-inch pipe leading from a 16 inch hydraulic main carries the gas into a 20-inch pipe in the adjoining retort house, and the gas passes along with and through the same course as the balance of the gas being made in the works; this being the case, I can give you no data as to gas production of the bench, either as to quantity or quality.

"The wagonnettes sent from France consisted of three coffers on one truck or carriage, and had a capacity of only 300 pounds each, which quantity of coal I found was less than the retorts could carbonize, the charges being thoroughly worked off in 3½ hours. I then had a larger wagonnette with two coffers made in this city and mounted on a truck of the same dimensions as the other, and now charge 500 pounds coal to each retort and allow the same to remain about 4¾ hours before drawing. The coke from these charges comes out thoroughly carbonized; clean, bright and hard, it is superior in quality to that procured from the best of our horizontally-set retorts. The coal shoots from the wagonnette through the feed hopper and spreads of its own gravity as evenly over the surface of the retort as if raked over by a spreading implement, and the two coffers are unloaded of the 1,000 pounds of coal in one minute's time from the opening to the closing of the feed hopper lids.

"A thimble or guard is pushed into each mouthpiece to keep the coal back from the same, and when an odd lump of coal rolls over this guard a corresponding quantity of tar produced from the same will flow from the mouthpiece when the lid is opened, but is actually no loss, as it is charged next time into another retort and converted into gas. When the charge is burned off the lid is opened, the torch applied to ignite the gas remaining in the retort, the guard or thimble removed, the coke loosened up by means of a light, flat spatula or poker, and rolls out of the retort within an average of two minutes from the time the lid is opened. The thimble then is replaced and the lid closed, after which the retort is ready for the next charge, as before described. The retorts run about eight weeks without requiring any removal of scurf. This operation is easily and rapidly performed by means of admitting cold air through a small opening below and leaving the hopper lid open.

"The incline of these retorts is such as to receive and evenly spread the average sizes of coal generally used in these works. We have tried half slack with half nut size, and find it spreads nearly as well as egg size or larger.

"When the five retorts are clean and working regularly 12,000 pounds of coal are carbonized during the 24 hours, and require for the same, with our common grate furnace, 3,412 pounds coke, or 28 pounds coke per 100 pounds coal.

"The ascension-pipes in this bench clog so seldom that a clearing auger is not used once in a week. This I attribute to the moisture afforded by the tar in mouthpieces before referred to. The seal on dip-pipes is set at 1½ inches, and the exhauster takes full 1 inch of this, leaving less than one-half inch of seal in hydraulic main.

"The conditions under which this bench has been operated have been unfavorable, the bench being isolated—built in a frame shed with roof leaking more or less in wet weather; yet from the quantity of coal carbonized and the ease with which the work is accomplished, I have no hesitancy in predicting that for coal gas this system will be universally adopted within a very few years.

"Regretting that I am unable to give you more minute and extensive details from the crude experiment of this bench, which, by the way, is in as good condition as it was one year ago, and bids fair to run as much longer, I remain, Yours very respectfully, John B. Taylor, Supt."

There is one special feature of this system of inclined retorts which is worthy of consideration, and that is the uniformity of the charge attained by the use of wagonnette. No matter how skilled the stoker may be, there are times when he is not at his best, and he cannot make a uniform charge throughout the entire retort. The charge of the wagonnette never varies; in 99 cases out of 100 it will be found to be the same. Not over four or five times during the operation of the bench at our works have there been stoppages or cloggings at the charging mouths, and these were so easily remedied that they cannot be considered for a moment as a disadvantage to the bench.

Mr. A. Arndt, Engineer of the Chicago Gas Light and Coke Company, who has experimented to a certain extent on a system of inclined retorts, has seen the bench in operation at our works, and was so pleased with its workings as to be induced to prepare a set of plans and drawings showing his own regenerative furnace under M. Coze's bench.

These drawings are here on exhibition, and will gladly be explained to any one who takes an interest in this subject.

Mr. Coze has erected one of his benches on the ground of the Paris Exposition, France, where any of you who are so fortunate as to be abroad this summer may see and investigate for yourselves. I have not heard from him recently as to the progress he has made with his system, but I am told that he has taken out patents and has his system in operation in England, France, Italy, Hungary, Germany, Austria, Belgium, and other places.

Now, then, it may be asked, what are the advantages of a bench of inclined retorts?

Is it more economical from a point of labor saving?

Does it give a larger yield per pound of coal carbonized?

Is it as easily operated as a bench of horizontal retorts?

Is it more expensive to construct than a bench of horizontal retorts?

In short, has it any material advantage over the ordinary bench now in use for the manufacture of coal gas?

All of these questions can be answered favorably to the bench of inclined retorts, except possibly the one as to yield; no definite data being given as yet on this point, as far as our experiments have gone.

The ease and facility with which charges are made and drawn, and the short time taken for the same, convinced me that one man can do almost as much work in a stack of benches of inclined retorts as two could do on an ordinary horizontal bench. I am informed that with a bench of 7 retorts and a regenerative furnace, such as that Mr. Arndt has placed under this bench, there is no reason why we could not charge 500 pounds of coal to each retort, and obtain the same average yield as that from any other regenerative bench now in use.

You may think this claim exaggerated; but I am reliably informed that one of our best gas engineers has not hesitated to make the statement that in any works well equipped with a stack of 10 benches of 7 retorts, such as those now here on exhibition, a saving of from 50 to 60 per cent. of labor can easily be made.

I must, therefore, say in conclusion that with a little experimenting on the part of our practical engineers with this bench, and a few improvements and additions to what has already been accomplished, we can justly claim it to be the "coming bench" for the manufacture of coal gas.

Having finished his paper the author further said:

In connection with the paper I wish to say that since I have prepared it I have received a letter from Mr. Arndt, which I think is a fitting supplement to the paper itself, and I will read it:

"CHICAGO, May 3, 1889.

"MR. WALSH—Inspector of the St. Louis Gas Light Company:

"*Dear Sir*—Your letter, of April 26, was duly received and in reply I will say that I estimated that each retort in the bench of sevens, built according to the drawings furnished to the Laclede Fire Brick M'f'g. Co., will carbonize 450 pounds of coal every four hours. This estimate is based on results obtained in our benches of horizontal retorts, heated by the same generator furnace as I proposed for the Coze bench. The size of retorts in our benches is 26 by 15 inches, by 9 feet long, inside measure. With 12 benches of sixes, being in action continuously for two years, the average charge for every retort in action is over 340 pounds every four hours. Taking into consideration the greater length of the inclined retorts and the almost perfect condition of the charges in those retorts, I believe that, with good gas coal, a production of 100,000 cubic feet can be reached and maintained with a bench of sevens. I am sure that with a regenerative system of heating the temperature of the retorts can be kept high enough to give such a production, but it requires a good deal of care and training to get high yields without having trouble with stand pipes and hydraulic mains.

"I am very glad that the question of inclined retorts will be brought before the meeting of the Western Gas Asssciation, because I am convinced that the introduction of this improvement is the most important step to be taken in the production of coal gas. The advantages of this system of charging and discharging retorts are so great that in my mind I have no doubt whatever about the inclined retort being the retort of the future. I know well that the use of inclined retorts is not new by any means—that they have been tried and abandoned long before this in several places; but the same has occurred with other improvements in our business, and still they were bound to come to the point and take their proper place. The best example of this kind is the invention of drawing and charging machinery for retort houses. How much money and mechanical ingenuity have been used to solve this problem and how many failures are on record, and still we all know that a perfect success has been obtained in this line.

"I am convinced that before long the gas fraternity will give Mr. A. Coze the full credit that belongs to his ingenuity and perseverance in working out his system of inclined retorts.

"I am very sorry that I cannot attend the meeting at Cincinnati; but our President, Mr. Forstall, is away on a vacation on account of ill health and I could not leave here. I should like very much to get the results of your experience with the Coze bench and I should be very much obliged if you would kindly send me a copy when your paper is printed. Very truly yours,

"A. ARNDT, Engineer."

Discussion.

The President—This is a very valuable and interesting paper, but I would suggest, however, that in discussing it we confine ourselves strictly to the subject, and be as brief as possible; for our time is limited, and we want, if possible, to read one more paper this afternoon.

Mr. Egner—Residing as I do in St. Louis, I have gone over to see that bench several times. Being interested in seeing how it would work—I had heard all sorts of stories about it—I went there when not expected. Not only did they not put me out, but they permitted me to go in and see it. I saw that bench charged—saw the coal go in, and from the time the first lump of coal went in until the lid was on it was just eight seconds. I saw the coal lying nicely and evenly in the retorts, just as described here, and I saw the coal well carbonized, and also saw as good coke there as I ever saw anywhere else. As you want brief statements, I think that is enough to say.

Mr. Somerville—Did I understand you to say that these are used in France?

Mr. Walsh—Yes; they were made there—five of them. We had not the plans or designs to make them here. They were made at Boulogne and shipped here. Because two of them were broken on the way over we had to have a couple of sections made here, but the latter have burned equally well with the French retorts; although, as Mr. Taylor says in his letter, these French retorts seem to have silicate in their composition, and appear to be more porous than the American retorts. The foreman of the works informed me that he is confident that the retorts will last two years longer. They are as good to-day as when the fires were put under them over a year ago.

Mr. Lansden—I would like to ask about the life of the retorts. If you never run a rake into a retort or never leave it open, it would make a very great difference in its life. What wears them out ordinarily is opening them during the periods the men are raking out the coke. I saw those retorts drawn three or four times, and I certainly thought that the question about drawing retorts was about settled. I saw a man take a rod, three quarters of an inch in diameter, flattened down at one end to two inches, and, after first looking in to see what the condition of the charge was, he ran the rod in, whereupon the charge all came out at once, or in a very few seconds. With regard to the quality of the retorts made in France, I think that if we take the proper material in the United States and treat it in the same way that the French treat it we will be able to get as good results in every respect. The retort is never open any length of time—never a rake or scoop goes into it to punch or break it. I think that that is largely why those retorts have retained their shape—because the cold air has not been suddenly thrown upon them as in retorts which are drawn by a rake.

Mr. Walsh—I did not intend to disparage the manufacture of retorts in this country, but was simply stating the fact that these retorts were of a different composition from our retorts. Yet the two sections made in this country stand equally well with those.

Mr. Lindsley—Is there not a very much larger formation of tar at the mouthpiece under those retorts than under the horizontal ones?

Mr. Walsh—Yes; it is a little larger for the reason that the thimble or guard which is put in is square, and that is shoved into the mouthpiece, so as to prevent the coal from coming right down against the lid. The coal, in falling, strikes this, and then gradually backs up, so that the iron lid at the mouthpiece is a little longer than in the ordinary horizontal retorts, but not much. It don't amount to anything.

Mr. Lindsley—The question I asked is as to the formation of tar from the coal. Is there not a much larger amount of it?

Mr. Walsh—I suppose that not over a pint or a pint and a half of tar will fall out when the lid is opened, which is due, as you will see from Mr. Taylor's letter, to the fact that lumps of coal will occasionally fall over the thimble or guard. They usually put a can underneath when they open the lid, to take the tar, and put it in with the next charge, so that there is nothing lost.

Mr. Egner—There is no more tar than from ordinary charges.

Mr. Shelton—What is the angle of this retort?

Mr. Walsh—Thirty degrees.

Mr. McMillin—I have been so interested in the inclined retort that I have made three trips over there to specially examine it. I think I was more favorably impressed the first time than I was afterwards. At that time the retorts, perfectly clean, were working nicely; and the drawing and charging was certainly quite as rapid as is claimed. It occurred to me that the chief advantage of the inclined retort was in being able to make them longer. We all agree that a foot on the back end of a retort is worth two in front, and if we can lengthen a retort, which amounts to adding at the back end, we can use the retort longer. This retort was, I think, nine feet; but hardly any limit can be put to an inclined retort. They will work very well. The second time when I looked at

the retort they had a great deal of carbon, and by timing I found that there was as much time lost, or occupied, in getting the coke to run out as it took for one man in our works to draw with a rake. While there was the same time, or a little more, expended, there was not a tenth part of the labor, because it was simply handling a little bar instead of a heavy rake. Still that can hardly be charged to be any defect in the retort itself. It is simply due to letting the carbon accumulate there longer than it should have been permitted to do. It would seem that the retorts were in the best possible shape almost to be kept clear of carbon. We have to go to a good deal of trouble to get the carbon out of horizontal retorts, by running pipes back in them and working it up front, and we have to do that to get a current through; but as the inclined retorts can have openings at back and front, and their position is such that there is a very rapid draught through, it ought to be quite easy to keep them clear of carbon. The fact that the retort could not be put at a steep enough incline to let the coke run out itself when the thimble was run out at the mouthpiece, without getting it so stopped that the coal would pile up at the front end, to accumulate and practically crack the retort, seems to be an objection. It would be very nice if one could take the thimble out, so that the coke would run out without the men standing there and pulling it; but we cannot have everything as we like. It is certainly a very much better retort than the horizontal retort.

Mr. Somerville—I would like to ask, how is the coal elevated to the top of the bench; and have you estimated the cost of so elevating it?

Mr. Walsh—I will state that as this bench was an experimental one we, of course, could make no estimate as to what a stack of benches would cost based upon the cost of this one. There is an ordinary elevator with tracks run by a simple steam engine, and a truck is run and elevated in that way to the top. Of course if there were a stack of benches the same elevator would answer for 10, or 12 or 50, but as it is it is used for a single bench. There may be other means of getting the coal there—probably by an incline, if there were a sufficient number of benches to justify it.

On motion of Mr. McIlhenny a vote of thanks was extended to Mr. Walsh.

The President—We will now have the paper by Mr. Mitchell.

Mr. K. M. Mitchell, of St. Joseph, Mo., next read a paper on

RETORT FURNACES FOR BURNING COAL.

Gentlemen of the Western Gas Association:—I was asked by your Secretary to read a paper on the subject of burning coal in retort furnaces. When I signified my willingness to do so, I did not know the difficulties I would have to encounter, from the fact that I had never written a paper or addressed an audience. And I am sure you will bear with me in my humble efforts to tell you what we are doing at St. Joseph at burning coal in retort furnaces. In order that you may fully understand our arrangement of benches, a short description will not be out of place.

Our original retort house is on the old style, and contains six benches of six retorts per bench; the widths of arches are 6 feet 6 inches; retorts, 14 x 22 x 8 ft. 6 in. inside measurement. We made plans two years ago for a stage-floor retort house of the following dimensions: 70 feet 9 inches wide, and 132 feet long, which will contain two double stacks of retorts, one stack containing six benches of six retorts, arches 7 feet 8½ inches wide, retorts 15 in. x 26 in. x 9 feet. The other stack will have five benches of retorts of the same dimensions. We have a section of this retort house built, and three benches out of four in operation. The old retort house, as before mentioned, contains six benches; and the flues were connected to a chimney situated just back of these benches.

We did not have a satisfactory heat with the old style of furnaces, in which we used coke; we, therefore, began to look around for something better, and came across the Oechelhauser generator furnace. This was in the year 1878. This furnace, as you know, is situated at the back of the bench, and had firebrick floor grates, with openings at the sides. We filled up five of these benches with this furnace, substituting grate bars for the floor grates and using steam to prevent clinkering. This left us one bench on the old style that we could not change on account of the chimney stack. So we concluded to try half-regenerative, digging a pit in front of this furnace to a depth of 4 feet 7 inches from bottom of the ash pan to bottom of the retort. In getting to this depth we were obliged to take out part of the concrete directly around the furnace. The distance from concrete to bottom of lower retort is 2 feet 10 inches. The furnace slants from the chute to within 5 inches of the ash pan. The furnace at level of grate is 3 feet wide, runs up several courses in height, and then is stepped forward on both sides to width of 14 inches, when it is covered over the whole length of bench from front to rear with tiling 5½ inches thick. These tiles have seven nostrils, 4½ inches long by 6 inches wide. The covering of the furnace is a most important point, and I believe that to Mr. George McIlhenny is due the credit of first calling the attention of gas engineers to the fact that a generator furnace to be successful must be under a slight degree of pressure. As before stated, our furnace slants from the charging chute at an angle of about 45°. The coal rests upon this slant and stepped grate, which holds the fuel from packing down upon the grates below.

The secondary supply of air is heated by passing around and between a system of "vertical organ pipes," as our friend, Mr. John Dell, has christened the arrangement. There are 13 of these pipes on each side, 3½ inches inside diameter, and 11 inches long, and 1½ inches thick. The waste heat passes down through them on its way to the stack. This arrangement of heating the air is most complete, and does not interfere with the draft of the bench. There is no traveling backward and forward of the waste gases; they simply pass down through the vertical pipes on their way to the stack. Their compact form allows of them being made very thin, and the waste heat is quickly and thoroughly absorbed by the air and carried back to do duty again.

The operation of the furnace is as follows: Suppose it to be running. We insert a bar into the chute, pushing the caked coal that lies on the slant and stepped-grate back into the furnace. After we have done this we fill with fresh coal the space made vacant by the caked coal thrown forward. The operation occupies but a few minutes, and is repeated every 1½ hours. Clinkering the furnace is accomplished by inserting bars to hold up the body of the fuel. Clinkering and barring up the furnace are done twice in 24 hours. We use lump coal in these furnaces, but nut coal can be used. It is only a question of more attention to the firing of the furnace. Lump coal costs us on an average $2.10 per ton all the year round. In 24 hours the furnace consumes 2,200 pounds of lump coal, carbonizing 9,600 pounds of coal in the retorts. Using coke in these furnaces, 60 bushels are required to carbonize the same amount of coal. Weight for weight of coal and coke give the same results in these furnaces. The question is simply one of money values in the two fuels. We sell our coke for 9 cents per bushel in the yard.

As I said before, lump coal costs $2.10 per ton of 2,000 pounds, making cost of coal for furnace $2.31 against $5.40 if we were to use coke—a clear saving of $3.09 per bench in 24 hours. After we had demonstrated the cheapness of this style of furnace over the generator furnaces placed at the backs of the other five benches, we changed them over to the above plan of working. We have an open pit 3 ft. 7½ in. deep from the floor line and 7 ft. wide, running the whole length of the benches. In the bottom of this pit we have half-round rails for track for traveling charging floor. In the section of the new retort house we have two double benches of 6's set upon the plan of A. Arndt, Engineer of Chicago Gas Light Company, for burning nut or slack coal. Excepting the manner of taking off the products of the furnace, the construction is the same as for coke. The gases, instead of passing directly up the bench, are led into a flue down the back of the furnace, and from there to the several ports or nostrils. Mr. Arndt's idea was to have the gases given off by the fresh fuel go down through the hot coke below, before they could reach the outlet flue and thereby be decomposed, consequently no smoke could get into the bench. With caking coal we found that it was impossible to draw these gases, given off higher up, down through this body of fuel, so were obliged to fire with a lighter body of fuel, leaving this flue at back of bench open for exit of gases. We have had two of these benches in operation 16 months, and they are giving us very good results.

In 24 hours we consume in this furnace 3,800 pounds of nut coal, carbonizing 10,800 pounds of coal. This nut coal costs us on an average $1.90 per ton of 2,000 pounds, or $3.61 per day. We are at the present time using pea coal in the Arndt furnaces, which costs us $1.50 per ton. This figured for a day's run would amount to $2.85 per bench, carbonizing 10,800 pounds of coal in 24 hours. I have with me drawings of the half regenerative furnace; also a drawing of a furnace on the plan of Mr. Arndt (with some alterations of my own) for burning slack coal, which can be had at 80 cents per ton. We will try this modification in the next benches we build.

	Furnace Coal Used in 24 Hours.			Per Cent. Coal Firing to Carbonizing.			Gas made pr front foot floor space	Cost firing Coal per 1000 cu. ft. Gas made.
	Pea.	Nut.	Lump.	Pea.	Nut.	Lump.		
Half regener'tive furnace	....	....	2200	....	....	22.9	5908	$0.06
Full regenerative furnace	....	3800	....	....	35.2	....	5590	81
	3800	....	....	35.2	....	....	5590	65

Discussion.

Mr. Dunbar—I would like to ask Mr. Mitchell what percentage of coke he would require?

Mr. Mitchell—Something over 25 per cent.; about the same percentage of coke as of coal.

Mr. Dunbar—Then there would not be very much of a saving?

Mr. Mitchell—We were driven, I might say, to the use of coal under our furnaces from the fact that we had a demand for the coke; so much so that we began using the coal in our old style furnace, and this led to our adoption of that plan of furnace. We are using that now entirely for coal for the very reason that we have a sale for all our coke at 9 cents per bushel. The same furnace will burn coke, and give these same results. It will consume about 60 bushels of coke and give the same results.

Mr. King—About a year ago I contracted for one of these furnaces, and have recently had it put in. It was fired up last week. I like the looks of it very much, and do not see why it will not do all that Mr. Mitchell claims for it. It seems to me that it will, if the figures he gives are sufficient to demonstrate that there is economy in it—especially where you can get cracked nut coal for fuel, and have a demand for coke. As far as the furnace is concerned I judge that you can get about the same results as you can from any ordinary half-depth furnace.

Mr. Somerville—I used coal, but I had trouble about the flues stopping up, and the debris collecting in the retorts. How is it with your furnace.

Mr. Mitchell—We have accumluations of carbon on the retorts on account of the supply of air. We gauge the feed of air to the furnace so as to give us about a medium supply of air. On the furnaces charging coal we probably make more smoke, but after the charge has been burned off there will be an excess of air. We gauge it so as to give it an even amount of air. This smoke that you speak of we dislodge by firing into the bench with a shotgun. (Laughter). In other words, we "shoot" the bench. At first when we tried the coal we had stoppage in the bench. I got one of those 50 cent fire-crackers and put it into the bench. It answered the purpose, but was rather expensive. So I sent Day to a second-hand store and got a single barrel shotgun, then took out the stopper right under the lower retort, and fired a shot off in there, which cleared the bench completely. If you do that once a week there is no stoppage of the bench. We have taken them out and found the flues perfectly clean—more so than if you were using coke.

Mr. Bredel—I think there is a much easier way of getting rid of the smoke, and securing complete combustion. In about 1883 I was in Lyons, France, where I got an order from Messrs. Limousin & Descours, lessees of the P. L. M. Railroad gas works, to construct a bench that would burn either slack or pea coal. We constructed a furnace that had a flue running from the back of the arch of furnace, and an opening of 2½ inches into each nostril, so that only a certain amount of air would pass in there and mix with the gas; in reality, after the manner of the Bunsen burner. Then the secondary air supply came on top of that. There was never any stoppage. I learn that they are using now in that furnace only 14 pounds of half slack half pea coal to every hundred pounds of gas coal carbonized.

Mr. Dunbar—I do not know how Mr. Mitchell got these figures by which he makes a saving of $3.09 per bench in 24 hours. He estimates the cost of the coal at $2.31 as against $5.40 for coke. He gets his coal at $2.10 per ton. That would make it about 20 per cent. less than he gets for his coke. If he uses 22 per cent. of the amount of coal carbonized—that is if it takes 22 per cent. additional to carbonize the amount of coal in the bench, and he could also carbonize the same amount of coal with 25 per cent. of coke, I do not see where the saving of $3.09 per bench would come in; because the latter is a saving of about 150 per cent.

Mr. Mitchell—Probably the percentage of coke would be higher than that. I have not figured it, but just jumped at that conclusion. I say we use very little coke. We don't use any coke. We are so particular about it that we have watchmen there to see that the men do not use any coke in the furnace. Probably the percentage of coke that is in the furnace—say 60 bushels—is probably more than 25 per cent. I have never figured that accurately.

Mr. Boardman—This is one of the instances in which this Association is a jury formed for the getting of individual experience—experience which each of us has not the opportunity to acquire; but by this means we can get the information second hand. The case, as represented here, is rather unique in this country, where coal can be purchased at a less price than the coke can be sold for; and as it is unique, very few of us could have had any such experience. As one of the members has had it, and has given it to us, it is of very great value; and I move a vote of thanks to Mr. Mitchell for his kindness in the matter. [Adopted.]

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

The President—We will now hear the report of the Committee on the President's Address.

Mr. McMillin—The Committee appointed to consider the suggestions embodied in the President's Address submit the following as their report.

The President and Members, Western Gas Association:—Gentlemen:—The committee appointed to consider the suggestions embodied in the President's address submit the following as their report.

We feel that our Association is to be congratulated upon having presented to it an address so comprehensive in its scope, so replete with fresh thought, so happy in its diction, and so convincing in the arguments presented. The address itself so clearly elucidates the numerous topics discussed, that the Committee feel that anything they may say—further than to earnestly commend the address as a whole—may rightfully be considered superfluous.

There are, however, two questions presented in the address which call for action by the Association, namely: "Increasing Membership" and the "Centennial." Respecting the first, the Committee suggest that there be 750 copies of the President's address printed in pamphlet form; that one copy be sent to each member of the Association, and one copy to the President of every gas company in the territory that may properly be termed Western (the term being here used in the sense it is used in the name of our Association), and that printed slips be attached to the cover of pamphlets sent to Presidents of companies, asking them to carefully read the address, especially that part referring to increase of membership, and to then hand the pamphlet to members of their Directory for their perusal.

We also suggest that this Association endorse the idea of properly observing, by an exhibition of appliances and otherwise, the centennial anniversary of the introduction of gas lighting, and that we respectfully suggest to the American Association that it take the general direction of affairs looking to that end.

Respectfully submitted,
EMERSON MCMILLIN,
E. H. JENKINS,
WM. STEINWEDEL,
Committee.

The President—What shall be done with the report?

Mr. L. Howard—This is the first time that I have observed in this Association the distributing of printed papers among the members before the reading, and I think it is a good point. Many engineering societies with whose rules I am cognizant follow the custom—some of them have four meetings per year. The papers are printed some time beforehand, and after each meeting they are sent by the Secretary to all the members of the Association. Then, twice a year they are fastened together and additional copies sent to each member of the Association—and all done at the expense of the Association. I would suggest that that may be a good idea for the Association to adopt as a rule with regard to all our letters and papers, including the President's Address.

Mr. King—I do not think Mr. Howard understands the question. If he will wait a moment we will dispose of that. The President asked what was to be done with this report; and it is proper that it should be disposed of first. I therefore move that the report be accepted, and the Committee discharged with the thanks of the Association—that their report be accepted and its recommendations adopted.

Mr. McMillin—There may be some here who would object to one of the propositions suggested in the report, and who would assent to the other. Perhaps it would be well to vote upon those two separately. One is about printing 750 copies of the President's address and sending a copy to the President of every company; the other is about endorsing the movement for a centennial celebration. Would it not be better to vote upon those two things separately.

The President—Perhaps it would. We will take up the adoption of the report first. As many as are in favor of adopting the report will say aye, those opposed, no. The report is adopted. Now the question recurs to the printing of 750 copies as designated by the Committee. [On being put to vote the recommendation was agreed to.]

The President—The next question is as to the endorsement of the recommendation of observing the centennial anniversary by this Association under the conditions of the Committee's report. Are you ready for that question?

Mr. McMillin—And referring to the American Association.

The President—Yes. [Adopted.]

(To be continued.)

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Roanoke (Va.) gas works have been purchased by Philadelphia capitalists, who, it is said, also control the water supply of the city. Important extensions are to be made on the gas plant.

AS stated some time ago, the Dorchester (Mass.) Company is now under control of the Bay State syndicate. The former executive management has been replaced by the following: Directors, Samuel Little, Eustace C. Fitz, J. E. Addicks, W. E. L. Dillaway, N. J. Rust, F. P. Addicks; Treasurer, F. P. Addicks; Clerk, C. R. Todd,

SOME time ago a curious case was tried in the Norfolk (Mass.) Superior Civil Court. One Johanna Conway, whose premises adjoin the works of the Brookline Gas Light Company, brought suit against the latter for damages, urging in the plea that she was unable to obtain full enjoyment of her possessions because of the dust that arose from the coal as it was handled in the gas works yard. She obtained a verdict, too.

MR. ELMORE, who is building the new gas works at Selma, Cal., says that $50,000 will be expended in the enterprise. That sum ought to give Selma a model works.

AT the annual meeting of the Kansas City (Mo.) Gas Light and Coke Company the following officers were chosen: President, M. J. Payne; Secretary, Walter Woolcott; Superintendent, A. G. Glasgow. The business of this Company keeps steady pace with the wonderful growth of the city.

"WHEN Messrs. Ivers Philips, C. W. Wilder, H. F. Coggshall, Alvah Crocker, Moses Wood and G. F. Bailey, met together (February 4, 1853) to initiate the Fitchburg (Mass.) Gas Company the outlook for success was pretty well clouded. On April 16, 1853, the projectors formally organized, but it was not until June 18, of that year, that it was determined to go ahead. Money was, as usual, rather hard to command, as will be understood when it is said that it took several weeks to raise 10 per cent. in cash on the necessary capital—the latter was fixed at $60,000. With the 10 per cent. in bank, it was agreed that Messrs. Ivers Philips and H. F. Coggshall should act as a committee to induce some contractor to put up the works, he to take payment in stock. Of course, this seemed to be a forlorn hope, but the committee finally found an agent, in the person of Mr. F. Benedict, of Rochester, N. Y., who accepted the terms. Benedict carried out his agreement fairly well, and when the works were completed Mr. Coggshall was installed Superintendent. Fitchburg did not first take kindly to gas light, and, at the suggestion of Mr. Coggshall, the shareholders, after much demur, adopted a resolution to pay no dividends for six years, but to bank the earnings for that period so as to have an assured working capital. At the end of the sixth year the cash balance amounted to $7,000, and out of that sum a dividend of 6 per cent. was declared. Since that time (1859) the stockholders have not failed to receive each year a sum *not less* than 6 per cent., and besides their well equipped gas plant they also own and operate the plant that formerly belonged to the local electric lighting company. In the meantime all the stock that was the portion of contractor Benedict—it was at one time very widely scattered—is now controlled in Fitchburg, where it is likely to remain. I ventured to send you these hints from the history of the Fitchburg Company, which go to prove how shrewdly and carefully its interests have been managed by Mr. Coggshall, who will shortly round out his thirty-sixth successive year in its service.—OBSERVER."

ON June 24 Edwin E. Winship, Trustee of a mortgage held by certain parties against the Circleville (O.) Edison Electric Illuminating Company, will sell at auction all the real and personal property of the aforesaid Company. The sale, which is to be absolute, will take place at 2 P.M. of the day noted, at the Circleville Court House. The plant and property is valued at $20,000.

MR. M. N. DIALL, of the Terre Haute (Ind.) Gas Company, is to be congratulated over the richness of his reward for pluckily maintaining that either oil or gas (if not both) existed in paying quantity in that locality. Since 1886 he has been prospecting for gas, and while many of his earlier associates tired of the search, because of lack of results, Diall kept right on, and now is to have his reward. The latter is in the shape of a 40-barrel well; yielding an oil of a gravity of .875.

THE proprietors of the Bellaire (Ohio) Gas Light and Coke Company having decided to add an electric lighting department to their business, will alter the title of the Company to that of the Bellaire Gas and Electric Company. All this was agreed on at the annual meeting, on which occasion the following officers were also chosen: President, Owen Mehan; Secretary, Miller Booth; Superintendent, John Ferguson; Directors, O. Mehan, R. A. McGregor, W. McMasters, W. J. Morrison, R. T. Devries, A. Loring, and M. Booth. The electric plant will be installed forthwith.

IN the competition for the public lighting of Williamsport, Pa., the Gas Company offered to furnish gas at the rate of $23.35 per post per annum, the contract to run for 5 years, 3-ft. burners to be used, lights to be maintained each night and all night.

THE projectors of the Mystic Gas Company, to operate in Mystic Bridge, Conn., have been successful in their petition for a charter. This place is on the Mystic river, at a point about 2 miles from the confluence of the latter with the sea, and boats of 400 tons can readily make harbor there. It is some 8 or 9 miles east of Stonington, and ought to afford a profitable field for a venture such as the one proposed.

D. C. SPRUANCE has at last induced the Trustees of Saratoga Springs, N. Y., to try the virtue of public lighting involved in the use of Westinghouse incandescent lamps, 25 candle power, nominal. According to the scheme adopted, Spruance is to supply 150 lamps of the power noted, the lighting hours to be from sundown until 1.30 A. M., and on 18 nights of each month, he to be paid therefor at the rate of $15 per lamp per annum; the contract to last for 5 years. He is also to supply like lamps for the engine houses, but is to be paid for these at the rate of $25 each per year. It looks to us as if Spruance had managed to secure a pretty good contract.

ON April 1st Mr. W.W. Prichard, Secretary and General Supt. of the Ironton (O.) Gas Company, notified the residents that the following gross prices would be charged:

For first 1,000 cu. ft., or less.....	$1.80	per 1,000
For next 2,000 " (1,100 to 3,000)..	1.70	"
For next 7,000 " (3,100 to 10,000)..	1.60	"
For all over 10,000 cu. ft.....	1.50	"

Payment of bills within 10 days from date of presentation secures a rebate of 5 per cent., which certainly is a guarantee that Mr. Prichard means to keep the Ironton Company well up in the list of suppliers of cheap (and good) gas. In addition to the above, the exposition of the Company's liberality may be further brought out in the remark that a special low rate is made on all gas consumed for cooking purposes in the period between May 1st and November 1st; which rate is also granted on gas used for heating from November 1st to May 1st. This special rate applies during the whole twelvemonth to all gas used for manufacturing purposes; the only condition being that at least 1,000 cubic feet shall be so used each month.

THE Queen City Electric Light Company, of Dallas, Texas, would not, it is said, object to entertaining a proposition from the Dallas Gas Company, the result of which would be the absorption of the former by the latter. The Dallas gas men, however, are quite cognizant of the value of their property, and not so greatly in the dark either as to the worth of the belongings of the electricians. This knowledge is quite likely to prevent a trade, and in the meantime the authorities are anxious to know why the Queen City Company does not keep up to its agreement with them in the matter of the public lighting. In connection with this, and to show how derelict the Company has been in respect to the fulfillment of its contract, we reprint the following report made to Council by the Committee on Lights: "On October 27, 1888, the city entered into a contract with the Queen City Electric Light Company to furnish the city 50 electric lights, of 2,000-candle power each, all night schedule, and if any additional lamps were needed the same were to be furnished at the same price, $95.85 per lamp per annum, and if the said Company should from any cause fail to light the city, or if any of said lights should fail to burn according to the conditions of the contract, the Company to forfeit double the amount of the contract price. Now, 125 lights have been ordered, and their locations designated, but only 85 have been furnished by said Company. Your committee have frequently asked to have the additional lights furnished, but have always been informed by the Company that they did not have the power, but that the same had been ordered from Fort Wayne. We are now of the opinion that sufficient time has elapsed to have allowed said power to have been placed in position in the Company's building. The committee are informed that notwithstanding the Company say they are short of power to furnish the lights ordered by your honorable body, they are daily contracting with private parties to furnish them with arc lights. Your commit-

tee also beg to invite your attention to the fact that the lamps furnished the city are not of the candle power called for in the contract, nor does the Company comply with the contract in keeping the lamps burning that are in use. Apparently no attention is given to lights that are extinguished when they should be burning, and while the Chief of Police is endeavoring to have all lamps not burning reported, it is impossible for that officer to perform the duties of an electrician. In the opinion of your committee the said Company do not employ the force necessary to see that the lights are kept burning." In addition to all this—and it would seem as if the indictment were already sufficiently strong—the committee further complains that the Company never painted its poles, as agreed on. Mr. Garrison, of the committee, supplemented the above by asserting that the people of Dallas, from one end of the city to the other, were complaining of the farcical nature of the so-called 2,000-candle power arcs supplied. The matter was referred to the city attorney. It may be taken for granted that that extra power will be a long time in transit from Fort Wayne, especially if its primal purpose is to furnish current for the additional lights that the city has the right to exact under the contract. It is a patent fact that arcs of 2,000-candle power each, burned on an all night and every night schedule, cannot be supplied in Dallas at a profit on a charge of $95.85 each per annum. No; it probably is not inability to secure additional power easily that prevents the Queen City Company from installing the 40 arcs that would bring the Dallas complement of arc lighting to the full. We might rather look for the reason to lie in the increased loss that would be occasioned to the contractors in completely accepting the provisions of their agreement.

THE sale by the city of Hamilton, Ohio, of the bond issue ($50,000), from the proceeds of which a start is to be made in the construction of a municipal gas works, was very successful. An award of the whole block was made to Messrs. N. W. Harris & Co., of Chicago, at their bid of $52,713.89. In our last we noted that Mr. James R. Smedberg had prepared for and submitted to Council plans and specifications for the works, and these, with slight modifications in the main system, were subsequently accepted by the authorities. It is agreed that the site chosen can be purchased for $3,500. We have said so before, and repeat it now, that the Hamilton taxpayers are making a very foolish as well as unjust move in this gas works project. They will, however, have ample time for repentance.

THE sale of the Rochester (N. Y.) Gas Light Company was completed on the 23d ult., whereupon the following organization was effected: Directors, D. Runkle, W. E. Stiger, F. W. Campbell, H. G. Runkle, W. Runkle, C. P. Robinson, R. A. C. Smith, T. Wood, and R. L. Cole: President, D. Runkle; Vice-President, W. E. Stiger; Secretary, F. W. Campbell; Treasurer, H. G. Runkle. Mr. Matt Cartwright, who for years had been the efficient Secretary and Superintendent of the Company, continued to act in the latter capacity until the 1st inst. Faithfulness nowadays does not count for much with the shareholder who wishes to part with his stock. And certainly Mr. Cartwright was faithful to every interest of the former owners of the Rochester Gas Light Company.

ON Saturday, May 25, quite a numerous party, by invitation, witnessed a trial run of the gas plant recently installed by the Toraya Patent Gas Company, at No. 2200 North 13th street, Phila., Pa., for the purpose of affording practical exposition of the Company's process. The trial is said to have been fairly satisfactory.

MR. J. C. VIRDEN, of Montgomery, Ala., has been chosen President of the "Home Consolidated Coal and Iron Company," whose properties are at Warrior, Ala. The product of the Warrior gas coal seams is well known to the gas makers of the South.

A CONCERN known as the Peoples Gas Company has purchased the gas plant formerly owned and operated in Newport, Ky., by the proprietors of the Dueber watch case works. The purchasers will apply to the City Council for the right to supply gas to the residents.

ONE of the latest acquisitions to the ranks of the fuel gas enthusiasts hails from Detroit, Mich. He is a plumber, and his name is Thos. D. Larkins, whose plant is thus summarized by a correspondent: "I heard the other day that Thos. D. Larkins, of 38 Larned street, who is jointly interested with J. A. Phelps and W. G. Wood in a patented gas process, had on exhibition at his shop something which promised to revolutionize existing methods of gas making, and being a restless sort of fellow myself, always ready to assist in a 'revolution,' I journeyed over to the plumbing shop, where I met Mr. J. A. Phelps, who kindly, albeit mysteriously, told me all about the virtues of the Larkins-Wood system. And this is what he said—before narrating the facts, I may perhaps be allowed to remark that the only revolution that will ever be effected by this process will be the revolutionizing of some house that shall contain one of the machines. That is to say, the revolution will be preceded or accompanied by an explosion. To come back to Phelps and the machine. 'There you see we have an ordinary air pump which forces air into that receiver, the latter being charged with certain chemicals, the composition of which is a secret. The air passes through the chemicals, and after its passage it is ready for use as a heating gas. Its cost to the manufacturer is about 10 cents per thousand. If illuminating gas is wanted all you have to do is permit it to absorb about 1¼ gallons of gasoline and you have a high candle power gas at a cost of 20 cents.' He told me much more, but as your readers I imagine are ready now to look at the next item, I will merely add that a concern, called the Electrical Gas Generator Company, capitalized in the small sum of $1,000,000, has been organized to push the sale of rights, etc. Despite the big capital Mr. Phelps (he is Secretary of the Company) thinks that the machines for the present will be manufactured in the Larned street plumbing shop.—J. T. F."

THE proprietors of the Oberlin (O.) Gas Company will engage in the supply of electricity. The corporate title has been changed to that of the Oberlin Gas and Electric Company, and the capital stock of the enterprise has been placed at $20,000.

DURING the last week in May a slight fire occurred in the premises of the Spencer (Mass.) Gas Company. The damage was slight.

THE situation at Pine Bluff, Ark., has been somewhat simplified through the purchase, by the Pine Bluff Water and Light Company, of the plant and franchises of the Southwestern Light and Improvement Company. In the meantime the original Richmond remains, and is likely to.

ONE of the features of the report read to the shareholders at the annual meeting of the Kansas City Gas Light and Coke Company was that which treated of the greatly extended use of gas for cooking and heating. While not positive about the figures, we believe this portion of the Company's sendout is close to 16 per cent. of the total.

THE Oakland (Cal.) Gas Light and Heat Company will put up a new holder (capacity, 150,000 cu. ft.) on its property at the foot of Union street.

BY way of variety to the usual practice, we call attention to the fact that the Baton Rouge (La.) Gas Company has "severed its connection" with the local electric lighting company. Cause, the gasmen were tired of keeping up the finances of the electric department.

ACCORDING to the amended articles of incorporation recently filed by the Omaha Gas Manufacturing Company, the nature of the business to be transacted shall be the manufacture and supply of gas for illuminating and heating purposes, and the supply and distribution of electricity. The capital stock shall be $1,500,000 the increased capital stock to be issued at such times and in such amounts as the Directors may name. The period of existence is fixed to terminate in 1950. The indebtedness of the Company shall not exceed $1,000,000.

THE annual meeting of the Pawtucket (R. I.) Gas Company will be held on the evening of Wednesday. It is earnestly hoped that Mr. Stiness will be able to occupy the Secretary's chair—he has been quite ill—and, certainly, an annual meeting of the Pawtucket Company, without Stiness in charge of the Secretary's desk, would be like an audience before an unpeopled stage.

GOVERNOR BEAVER, of Pennsylvania, has signed Senate bill No. 272, which amends the Corporation Act of 1874 to the point of permitting road, bridge, ferry and gas light companies to borrow money in amount double that of their paid-up capital stock.

THE Controller of Detroit, Mich., has been instructed to advertise for bids for lighting that city by electricity, for a term of three years, from July 1, 1890. The propositions are to be submitted under four headings: First, for the purchase of the present poles and wires; second, for the equipment of the city with a municipal plant; third, bids for lighting under the present (Brush) system; fourth, for performing the work

under some other system. All bids for lighting must be made on the basis of underground wires within a radius of a mile from the City Hall. The competition will terminate about July 20th.

THE first result of the absorption by the Conshohocken (Pa.) Electric Light Company by the local Gas Company is an increase in the gas rate to $1.80 per thousand from $1.50.

"The contest is over (at least for the present) and the victor is returned as the Hartford City Gas Light Company; but the latter never was called on to work so hard before for victory. Putting one thing against another, I do not think that a like comedy of errors was ever played by legislative comedians. First we were treated to a lot of balderdash testimony, some of it said to be of the expert type, at that. Members of the upper and lower branches of the Nutmeg State Legislature were all but choked with statements concerning heat units—did it ever strike the readers of the JOURNAL how often some of the disputants at the Association meetings take refuge in 'heat units' when sc mingly driven to the wall—calorific intensity, specific gravity, odor, etc., the whole argument always concluding in the round-up that the people were crying loudly for fuel gas—of the Loomis type. And while on this division of the topic permit me to remark that the impression is that all this speechifying and buttonholing is to be held accountable for the state to which Mr. Baxter, of the joint Incorporations Committee, was reduced; who evidently was so dazed by it all that he did not know whether he had signed the majority or minority report of that committee on the subject. His signature, however, was appended to the former. Turning away from the testimony, and Mr. Baxter's dazed condition as well, we now come to the discussion by the Senate of the proposition to permit the Hartford Light and Power Company to distribute fuel gas in Harbisonville. On the eventful day Mr. Fuller led off for the affirmative in a rather weak speech, not made any stronger by his contemptuous allusion to the petition (previously offered by Mr. Cleveland) whose signers protested against the proposed grant. Mr. Fuller remarked that the petition seemed to be merely an abstract of the Hartford tax list; and were I him I would not have offered that as an objection, since if the signers of a petition can also be identified as taxpayers, they ought to have weight with even lawmakers—and they usually do. After Fuller finished, Mr. Cleveland, who paid no attention to Mr. Fuller's abstract criticism, said that not one of the Senators present knew what water gas was, although many of them seemed to think that all Hartford—more particularly the poorer residents, who had never burned a foot of gas in their lives—was crying out for the benefits of the Loomis process. Having noted that it was proposed to distribute fuel gas through the leaky pipes of the dead or dying steam company, Mr. Cleveland called attention to the ability and willingness of the existing Hartford Gas Company to supply gas for fuel wherever the latter was required. He thought it would be time to charter a fuel gas company when the old Hartford concern admitted its inability to cope with the gaseous necessities of the city. Senator Cowles wanted it understood that he knew something about water gas, and quoted its use in New Hartford and Winsted as a proof of the fact. Senator Hall opposed the scheme, giving reason therefor that he thought the Hartford Gas Company, should be protected while it served the people; he would vote for the measure were it a fact that the Hartford Company did not do so. Senator Clark brought down the audience by remarking that in his opinion graveyards would outstrip cities if the untrammelled supply of an odorless water gas were permitted. Another telling point made by him was that the old Company furnished last year 21,000,000 cu. ft. of gas for fuel purposes, and that the Hartford Company's illuminating gas when used in that manner was cheaper at $1.40 per thousand than the opposed Loomis article would be at 65 cents per thousand. Senator Coffin opposed on the ground that one gas company was enough for any city, and Senator Corbin shared in the same view. By this time Senator Fuller was pretty well worked up, and when he again succeeded in catching the presiding officer's nod his tones were rather unsteady—his arguments even more so. In effect his prayer was that as the Light and Power Company could not make anything out of selling steam heat, it ought to be allowed to distribute fuel gas. He also sarcastically alluded to the fact that as gas prices are reduced the gas seems to go faster through the meters. He then playfully cited an instance of this: A prominent citizen of Hartford—Mr. E. W. Parsons—in 1867, when gas was at $4 per thousand, paid $53.73 for his year's supply, whereas in 1888, with gas at $1.40, his bills were $45.64. He used the same number of burners in each year. Senator Cleveland, however, punctured poor Fuller by asking the latter if Mr. Parsons did not employ a gas cooking stove in the summer of '88; and silence gave consent. The resolution was then put to vote, and it was rejected by 4 in favor to 12 against. The petitioners were then given leave to withdraw. In the meantime, although Harbison could not go to the Western meeting last month, he was up to Lawrence at the last meeting of the Guild.—HADDAM."

WE understand that the proprietors of the Millville (N. J.) Gas Light Company are negotiating for the plant of the Millville-Schuyler Electric Light Company.

AS usual, the Maine man comes out of his shell to speak to an original proposition. The specimen referred to resides in Portlaud and he is to bring suit against the electric light company for damages, because the company's arcs keep his hens (the Maine man is a chicken raiser) awake until midnight. On this account, he says, "the hens, being worn out for want of sleep, are too tired to lay."

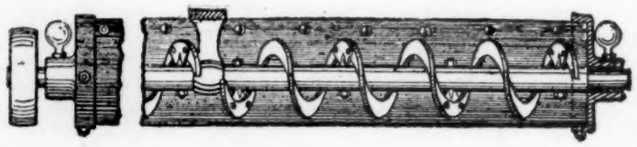
THE Dedham and Hyde Park (Mass) Gas and Electric Light Company recently received the following invitation, from the Committee on Street Lighting, to bid on the public lighting. The measure of gall contained therein can be easily estimated, if the wording of the "invitation" is carefully followed: "You are invited to mail, under seal, to the Committee on Electric Street Lighting, Selectmens' Room, Dedham, Mass., not later than June 1, 1889, proposal for lighting by electricity the streets of Dedham village, East Dedham, West Dedham and Oakdale, all in the town of Dedham, for $5,000 per year, from a plant to be erected in Dedham, and operated by yourselves, on a contract of 3, 5 or 10 years. Said proposal to state the number of arc and street incandescent lights you will furnish for that sum of money; the actual candle power of each light, the number of hours or nights you will burn said lights; the location of each light and the kind and quality of poles and wires which you will use. Said proposal also to state what will be the additional cost of placing the wires underground, on High street, from Memorial Hall to the Common; the wires and appliances for lighting the streets to be so arranged, constructed or insulated as not to seriously affect the telephone service in said Dedham; said proposals to state what agreements favorable to the town you are willing to make, and especially for the protection of the town against liability for damage by fire caused by your plant or wires; against imperfect or defective lighting or failure to light during any part of the term contracted for, and for reduction in the price per light, in case the *cost of electric lighting of streets* shall be *materially reduced during said* term. The Committee reserve the right to reject any proposition which is not in their judgment for the best interest of the town." For perfect frigidity, the above should be awarded the ice. Perhaps Dedham would be a good point to operate a municipal lighting station.

WE are indebted to a correspondent for the following particulars respecting the last annual meeting of the Portland (Me.) Gas Light Company: "From the report of President Daveis it is seen that the consumption of gas for the past year was 48,856,000 feet—an increase of 389,000 feet over the preceding year. The number of consumers is 2,921—an increase of 57. Four thousand nine hundred and fifty-one tons of coal and 110 tons of oil have been carbonized, producing 57,819,000 feet of gas, of illuminating power averaging 18.9 candles. Ninety-four thousand four hundred and eleven bushels of coke have been sold, and 233 barrels of tar. Two thousand three hundred and ninety feet of 4-inch mains and 241 feet of 3-inch have been laid on Congress, St. John, Sherman, Spring, West, Charles, and Crescent streets. A small brick building for restoring the iron turnings used in the purifiers has been built, at a cost of about $600. A new exhauster was contracted for last year to be delivered by Aug. 1, as the change could best be made when the consumption of gas was small. It did not come until October, too late to be set last year—and therefore was not paid for. The cost will be about $850, and will be in the accounts of the current year. The expense of all other renewals and repairs for the year will be very small if nothing unforeseen occurs. The loss of gas from leakage has been larger than usual, amounting to nearly 14 per cent. This was owing to some bad breaks of the mains that were difficult to locate when the ground was frozen, and to leaks in disused service pipes, principally those leading to the direct lamp posts. The mains have been repaired, and many surface pipes not in use have been cut off and plugged at the mains. There has been for some time a feeling on the part of the city that it should be represented on the Board of Directors. A share of stock was issued to the city gas agent, Alderman Thomas P. Shaw, to enable him to assume that position, with the understanding that at the close of his term of service it be transferred to his successor as city gas agent. These were the Directors elected: Edward H. Daveis, Chas. B.

Merrill, Wm. W. Thomas, Wm. H. Moulton, Fred N. Dow and Thos. P. Shaw. After organizing, the board re-elected E. H. Daveis, Esq., President, and Samuel Rolfe, Esq., Treasurer."

The Combination Conveyor.

Messrs. Little & Stephenson, London, England, who have had much experience in the construction of different forms of conveyors, are now in the market with a type of this useful apparatus that seems to embody the leading structural principles adhered to in two or three of the best conveyor forms that are in use. The adapters, too, do not claim originality for the main ideas of their system, since it has been named by them the "Combination." Although the latter term suggests complexity, in effect the new apparatus has its chief merit in its simplicity. The conveyor proper, as will be seen from the drawing, consists of a simple spiral, which is connected to the central spindle by means of ordinary paddle blades, not unlike those employed in the formation of an Archi-



median screw. Briefly, then, the "Combination" may be considered as an amalgamation of the Archimedian, paddle blade and spiral forms, which is equivalent to a combination of their individual strengths, with a consequent increase of their conveying capacity. It is likely that the liability to wear and tear is reduced, though the builders do not go to the other extreme of urging the entire absence of friction—not long ago put forward by a French genius, who asserted that he had constructed a conveyor wherefrom the friction encountered was *nil*. The "Combination," however, showing, as it does, a minimum of periphery surface, abundant strength, structural simplicity and high transmitting power, seems to possess the essentials of the ideal conveyor.

When it is intended for the transmission of grain, cement, chemicals, dross, sugar, salt, ground minerals, and kindred materials, the spiral is made in the form of a flat or taper steel bar, which gives the advantage already alluded to of an almost frictionless periphery, and the desideratum of a continuous propelling face. In conveying material, whether it be in a finely ground, granular, lumpy, fibrous, hot, cold, wet, dry, plastic or sticky condition, the formation of the flat spiral, with the frictionless periphery, is calculated to insure that the motion which the "Combination" conveyor imparts to the material it transmits is of a parallel kind, almost equal to the speed imparted by the pitch of the spiral. Continuity of transmission, for the full area of the trough, is thus obtainable.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

A Rejoinder from Messrs. Henry Pratt & Co.

OFFICE OF HENRY PRATT & CO.,
875 South Halstead Street, Chicago, May 7, 1889.

To the Editor AMERICAN GAS LIGHT JOURNAL:

An "Important Notice to Gas Companies of the United States," which was directed principally against us, and issued by the National Gas Light and Fuel Company, March 20th, 1889, stated that our apparatus was an infringement on certain patents owned by them, and also that the statements which we make in our circular are not true, as indicated by statement signed per John Zimmerman, Secretary.

We append the statements of disinterested parties, and also the decision of the Commissioner of Patents, which gave us Patent No. 361,078.

This case was commenced by Mr. T. G. Springer, in the Patent Office, and carried on by the National Gas Light and Fuel Company.

The claim made by the National Gas Light and Fuel Company, that we infringe on their patents, we aver is not true. As we build our generators strictly in accordance with our claims and our patents, we do not want any of their constructions. The representatives of the National Gas Light and Fuel Company have claimed that the generators built by the West Side gas companies of Chicago, since 1884, are Springer generators, but they were in fact built under our patents.

The statements made by C. D. Hauk, Manager, and per John Zimmerman, Secretary, do not change the facts. The generators show for themselves to any one who will examine the internal construction and compare them with our patents and claims. But the question cannot be settled with circulars or advertising dodgers. The suits which the National Gas Light and Fuel Company have so widely advertised as being commenced against our apparatus will come to as speedy a trial as can be had, and the controversy definitely settled in the courts. We believe that we have the best system for making illuminating or heating gas that there is in the market, and we also believe that parties who use our apparatus will fully corroborate this statement, and we thus leave our work to speak for itself. HENRY PRATT & CO.

[Copy.]

UNITED STATES PATENT OFFICE.—*Springer vs. Pratt and Ryan.*—Gas Generators.—Appeal from the Board of Examiners-in-Chief.—Application of Theodore G. Springer filed January 22, 1885.—Application of Henry Pratt and John J. Ryan, filed November 19, 1884.—Messrs. Peirce and Fisher, for Springer; Messrs. Wm. W. Lotz & Co., for Pratt and Ryan.

I have no hesitation in declaring that the patent CANNOT be granted to Mr. Springer. I have no doubt and entirely concur with both tribunals below in the view that Pratt and Ryan conceived the invention in question early in 1884, reduced the same to practice during the summer, and filed their application the following November.

Mr. Springer claims to have conceived as early as the year 1877. He did not, however, file his application until more than two months after his adversaries. There are at least grave reasons for belief that Springer's application would never have been filed had not Mr. Cowdery exhibited to him the drawings of Pratt and Ryan.

If Mr. Springer reduced to practice the invention in controversy as early as the year 1877 or 1878, of course, I think I should be compelled to hold that the same was fairly abandoned by him to the public, in which event it need not be said that no one would be entitled to patent the invention. I am not satisfied, however, that he did so reduce to practice, and I therefore concur with the Board and with the examiner of interferences in awarding priority to Pratt and Ryan.

Nov. 22, 1886. M. V. MONTGOMERY, Commissioner.

CHICAGO, May 7, 1889.

I made drawings for gas generators for the Peoples Gas Light and Coke Company, in the year 1886, and the Illinois Light, Heat, and Power Company, of Chicago, in 1887 and 1888, under the directions of Henry Pratt, as shown in the circular issued by Henry Pratt & Co., 1888. The construction is also shown and described in letters patent No. 361,078, issued to Pratt and Ryan, and to my knowledge the same was built in accordance therewith. RUDOLPH SCHENCK, M.E.

CHICAGO, May 7, 1889.

The tiles for the Peoples Gas Light and Coke Company's generators and for the Illinois Light, Heat, and Power Company's generators, as shown in the circular of Henry Pratt & Co., issued in 1888, and also shown and described in letters patent issued to Pratt and Ryan, and numbered 361,078, were made at our factory under the directions of Henry Pratt, in 1884, 1886, 1887. GEORGE C. HICKS, Prest.

The Electrical Plumber.

The *Scientific American* calls attention to the fact that the extensive adoption of lead-coated cables for subway electrical lines has given birth to an occupation which is in some sense a new trade—the electrical plumber. The subway cables have to be joined at frequent intervals, at the least at every second manhole. In uniting the ends, the skill of both electric lineman and plumber is required. A cable may contain a hundred or more wires, which may be grouped in pairs to add to the complexity. To join such a cable the wires have to be properly connected with each other, each splice has to be carefully insulated with tape or equivalent wrapping, and finally a sleeve is slipped over the joint and secured by two wiped joints. At this point the lineman has to change his trade and become a plumber, when he "wipes" the joints at each end of the sleeve, so as to protect the wires perfectly from moisture. Much other work falls within his scope. Lateral connections have to be made. One or more wires have to be picked out and led to one side or the other on new routes. As the system grows in extent, so will his work increase in complexity. In fact, what is to some extent a new trade has been created. It is said that there are now about one hundred skilled electrical plumbers in this country, and that the best men are well known and are in constant demand.

THE AMERICAN
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Germany.—B. WESTERMANN &CO., of New York.

MONDAY, JUNE 3, 1889.

The Market for Gas Securities.

The market for Consolidated was steady during the week, and the feeling in respect to the future is all in favor of better prices. There can be no doubt about it that the visible supply of floating stock in and around Wall street is steadily diminishing, and that the shrinkage is chargeable to absorption by investors. We look for it to reach par before next dividend time. There is some inquiry for Standard preferred, but it is hard to get an accurate quotation for it. Mutual is fairly steady, and we incline to the view that it is a good purchase at current offering rates. Equitable maintains the advance of a week ago, with a fair prospect that a still further increase in its value will shortly be recorded.

A surprising feature in connection with local electric lighting shares is the lack of confidence manifested by investors towards what seem to be valuable properties, judged at least by the dividends paid. Take, for instance, the case of the Brush Illuminating Company, which, although returning 8 per cent. per annum, can be bought in lots to suit at, or even below 75. The Edison Illuminating Company, which may be classed as a fairly reliable 4 per cent. stock, can be bought at 80, and so it goes through the list. People are afraid of these shares as a whole.

Over in Brooklyn nothing of interest is to be reported, unless one wishes to retail that which seems to be highly colored by fancy. The tendency there, as in New York, is to strength. Some inquiry was made for Brooklyn gas, and by good parties, too; but the difference between the prices offered and wanted was too great. It is reported from Central New York that a new syndicate has been formed for the purpose of absorbing well-established gas properties in Central New York. They are said to intend to follow the opposition charter plan. Watertown has already been visited, Oswego is to be next, with Syracuse to follow.

In our opinion they will have quite a job on hand in the latter place. Syracuse might be purchased, but it will never be plundered. There is no doubt now that Chicago Trusts are to enter the list of dividend payers; the rate to be 4 per cent. per annum. The Chicago bond issues are all strong and higher.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

16 WALL ST., NEW YORK CITY.

JUNE 3.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	89	89½
Central	500,000	50	80	92½
" Scrip	220,000	—	47	57
Equitable	4,000,000	100	125	—
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	102	105
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern	125,000	50	30	—
" Scrip	108,000			
Yonkers		50	90	100
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	104	106
Citizens	1,200,000	20	72	75
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	120	123
" Bonds	300,000		—	106
Peoples	1,000,000	10	71	73
" Bonds (5's)	368,000	—	97	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	88	90
Nassau	1,000,000	25	111	113
" Ctfs	700,000	1000	100	103
Williamsburgh	1,000,000	50	119	122
" Bonds	1,000,000	—	109	112
Out of Town Gas Companies.				
Boston (Mass.) Gas Co	2,500,000	500	240	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	150	—
" " Bonds	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	59⅛	59⅝
Cincinnati G. & C. Co.	6,000,000	100	214	218
Consumers Toronto	1,000,000	50	192	—
Central, S. F., Cal.			75	90
Capital, Sacramento, Cal.			58	
Consolidated, Balt.	11,000,000	100	43½	—
" Bonds	6,400,000		107	107½
Hartford, Conn	750,000	25	120	130
Jersey City	750,000	20	165	170
Laclede, St. Louis, Mo.	2,000,000	100	140	—
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	204	210
Memphis (Tenn.) Gas	750,000	100	48	51
" Bonds	240,000	100	103	—
New Haven, Conn		25	193	197
Oakland, Cal.			34	36
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
St. Louis, Missouri	600,000	50	—	—
San Francisco Gas Co.			60	60½
San Francisco, Cal.	10,000,000	100	59¾	60
Washington, D. C.	2,000,000	20	190	194
Wilmington, Del.		50	200	208

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As Superintendent of a Gas Works

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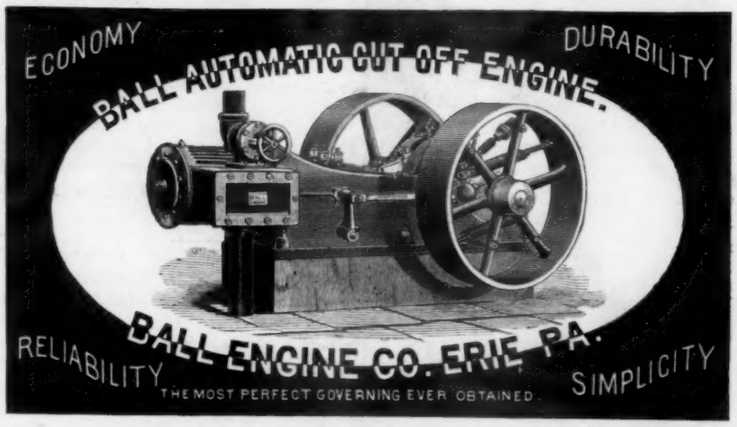

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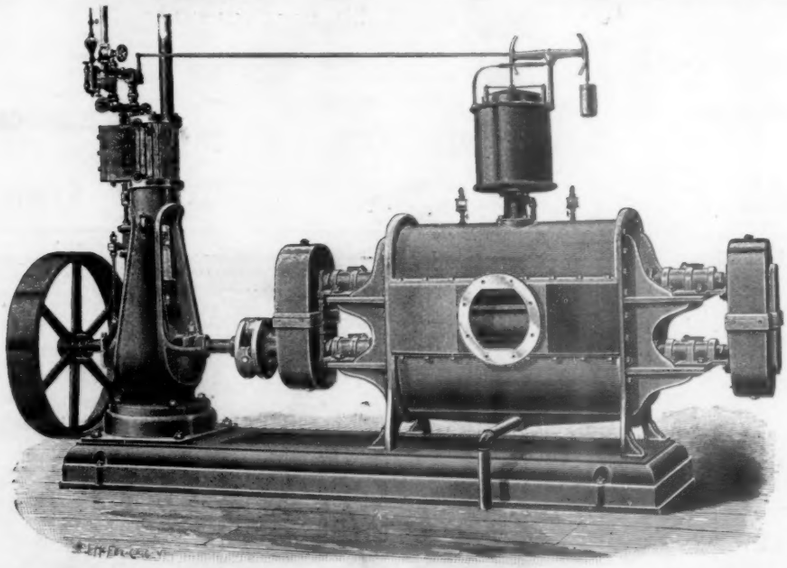

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Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Areschon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
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Baerlien & Co	20,000
"	20,000
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" Citizen	500,000
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Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
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"	1,000,000
" **Nassau**	1,000,000
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Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

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Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A.	350,000
Denver, "	500,000
" "	1,000,000
Dusselldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A.	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A.	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A.	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

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Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

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Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	500,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A.	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A.	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A.	750,000
Magdeburg	300,000
Memphis, U. S. A.	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A.	680,000
Northfleet	200,000
New York, U.S.A.	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
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Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W.	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Planen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A.	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
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Richmond	1,500,000
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Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A.	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A.	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A.	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A.	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A.	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A.	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A.	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A.	2,000,000
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Worcester, U.S.A.	750,000
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Los Angeles Gas Co.	Los Angeles, Cal.
San Diego Gas Fuel and Electric Lt. Co.	San Diego, Cal.
Sioux Falls Gas Co.	Sioux Falls, Dak.
Dakota Gas and Fuel Co.	Grand Forks, Dak.
St. Johns Mutual Gas Co.	St. Johns, Mich.
Stillwater Gas Light Co.	Stillwater, Minn.
St. Paul Gas Light Co.	St. Paul, Minn.
Emporia Electric and Gas Light Co.	Emporia, Kas.
Van Wert Gas Light Co.	Van Wert, Ohio.
Lansing Gas Light Co.	Lansing, Mich.
San Francisco Gas Light Co	San Francisco, Cal.
Shelbyville Gas Light Co.	Shelbyville, Ind.
Great Falls Gas Light Co.	Great Falls, N. H.
Belleville Gas Co.	Belleville, Ontario.
Rochester Light and Fuel Co	Rochester, Minn.
Northwestern Gas Light and Coke Co.	Evanston, Ill.
Lincoln Gas Light Co	Lincoln, Neb.
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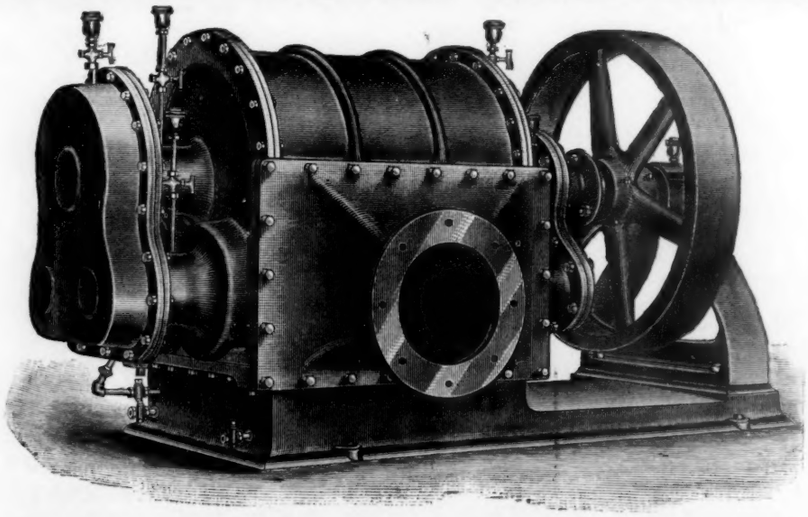

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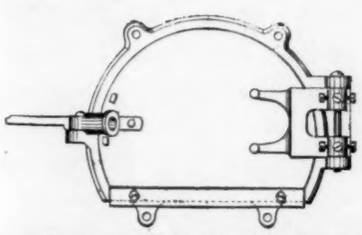

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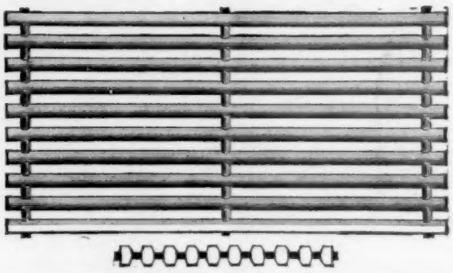

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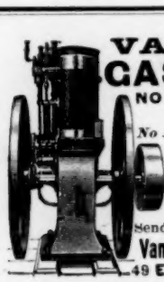

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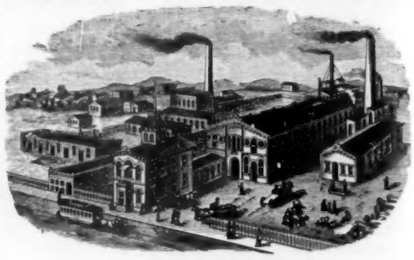

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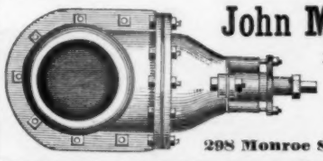

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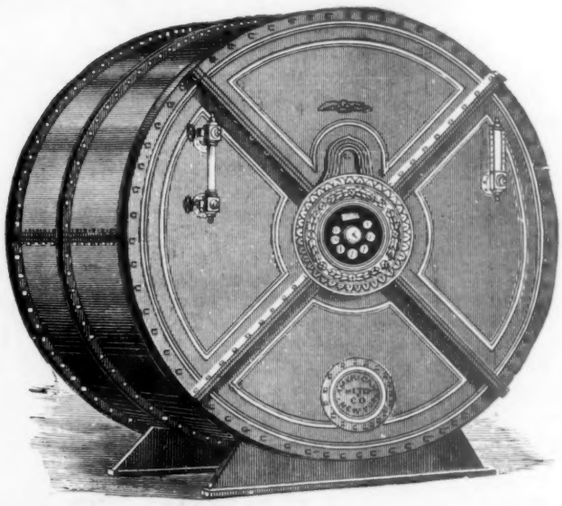

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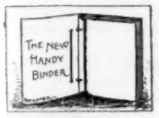

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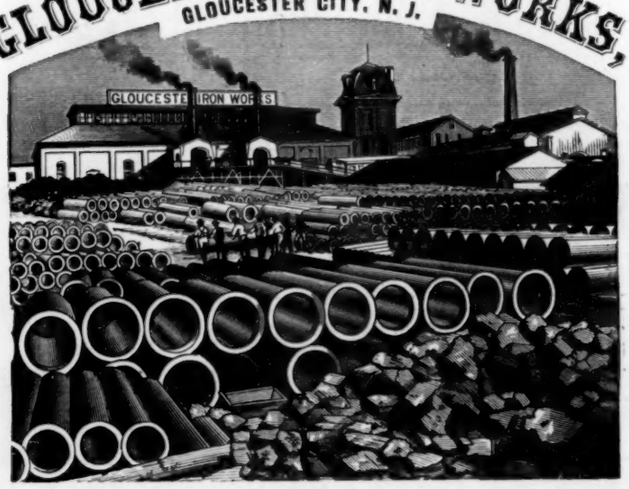

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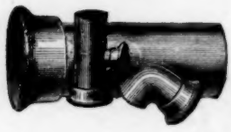

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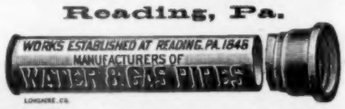

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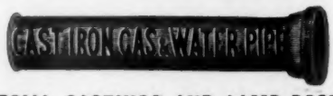

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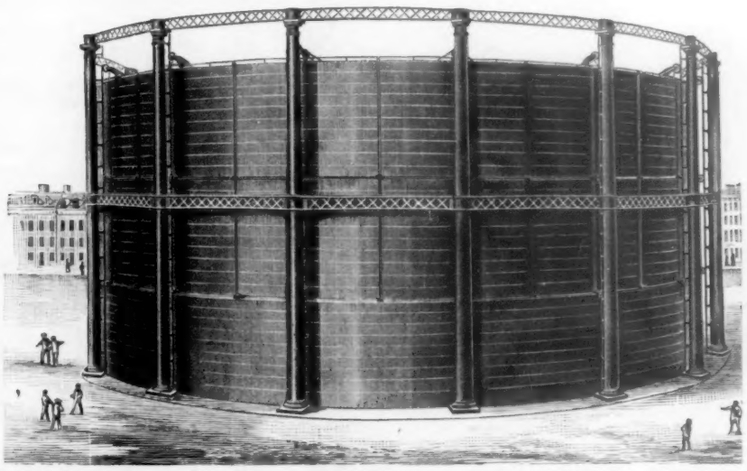

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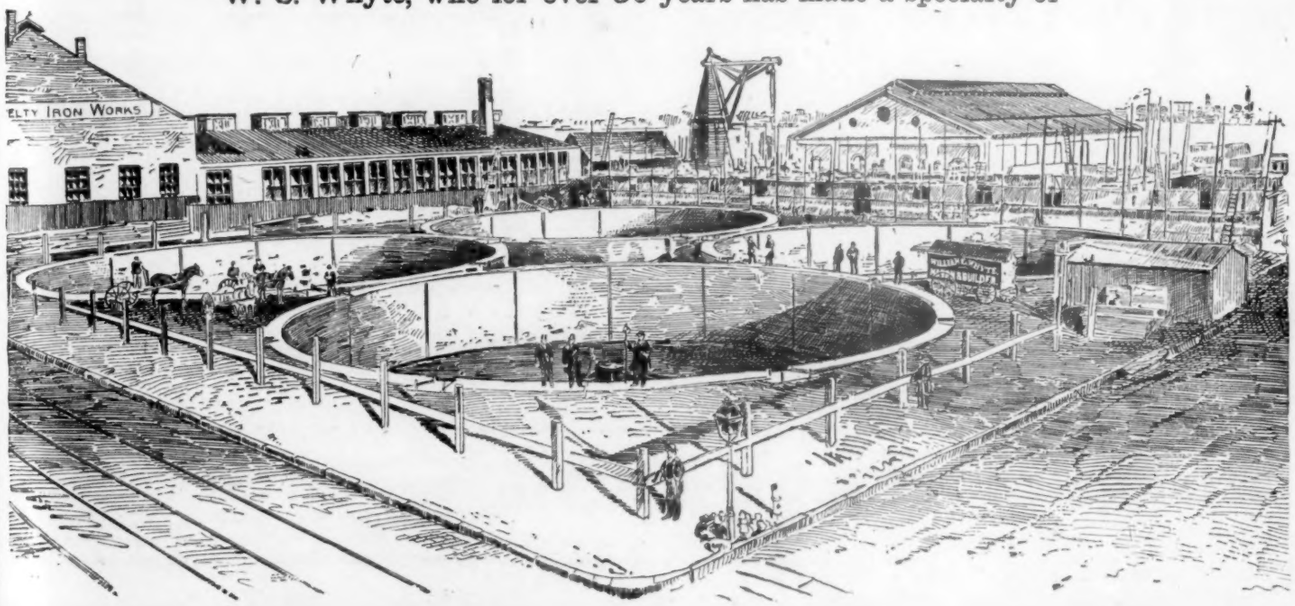

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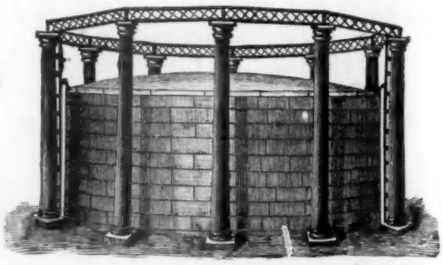

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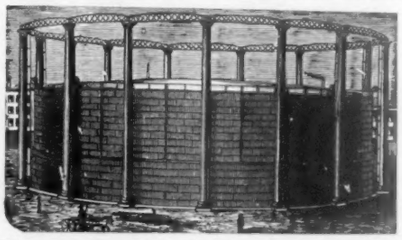

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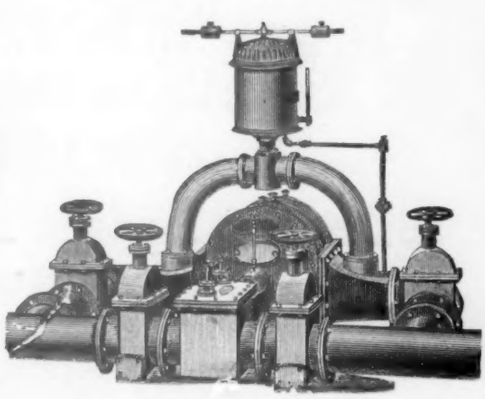

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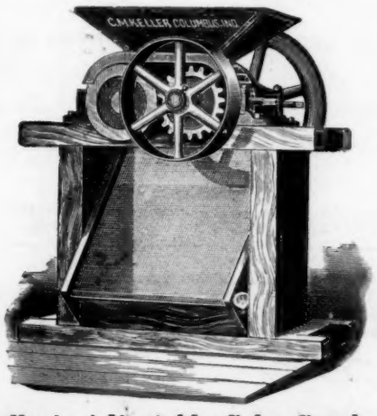

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4,500 lbs. Indiana nut and slack, at $1.30 per ton	$2 93
Engineer, one night, at $50 per month	1 67
Trimmer, one day, at $40 per month	1 33
Superintendent or Electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent, one day, at $40 per year	11
Wheeling coal and removing ashes, at $4 per week	58
100 pairs carbons, at $18.50 per 1000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$10 38

50-H.P. OTTO GAS ENGINE, Running a Plant of Fifty 2000 C.P. Arc Lamps 12 Hours.	
9,200 cu. ft. gas, at 42 cts. per M. (for cost of gas see items below)	$3 86
Engineer not needed; engine is in care of Electrician or Supt.	....
Trimmer, one day, at $40 per month	1 33
Superintendent or electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent dispensed with (cooling water used over and over)	....
Handling of coal included in cost of gas	....
100 pairs carbons, at $18.50 per 1,000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$8 95

Expenses of depreciation, repairs, and interest omitted, being considered the same in both cases—though depreciation and repairs are much higher with steam on account of boiler and its appurtenances. Cost of gas in the holder we estimate for most of the Middle and Western States as follows: Coal, 30 cts.; labor, 20 cts.; purification, 2 cts.; total, 52 cts. Less coke, 7 cts., and tar, 3 cts.; leaving net cost of gas 42 cts. The items of Superintendence and repairs, being paid for by the gas sold to consumers, need not be charged on extra output for gas engine consumption. Where the cost of gas is higher than here figured, coal for steam use will be found proportionally higher, and final figures of comparison show same amount of saving.

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